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FIRST PART
ORIGINAL ARTICLES

**The Mycoplasma Theory.
Its Scientific Importance and Practical Significance.**

by

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A. — THE RUSTS OF CEREALS.

a) *The Usual Opinion as to their Origin and Propagation.*

The terrible injury caused by rust to the oat crop in Sweden in 1889, causing a loss estimated at 16 million crowns, caused the Swedish Government in 1890 to allocate a special sum (10 000 crowns) for a further and thorough investigation of this disease. The work was entrusted to the National Institute of the Royal Agricultural College at Experimental Station near Stockholm. The experiments were to be carried on for three years under the direction of the author. Observations were made even during the preliminary investigations that were not in accordance with the generally-received opinion, according to which the origin and spread of the rusts are due solely to the spores of fungi (uredospores, teleutospores and chasmodiospores), occurring in the neighbourhood. Moreover, these observations which were based on the facts mentioned later, proved without doubt that these fungi existed under another evolutionary form.

Let us first recall the studies made in the open in wheat-fields, on grass and in forests. The most striking results were obtained in the experimental field, in small plots, usually 3 m × 3 m, in which were grown at different times, many (300-400) varieties of rye, wheat, barley, oats and certain forage Gramineae, the seeds coming from different parts of Sweden and abroad. The growth of these plants was followed every year without

interruption and with the greatest attention from sowing to harvest. The first appearance of the pustules of the different forms of rust was especially noted and also the manner and intensity of their development. Every week or fortnight and in some cases every day, similar observations were made. These studies gave important and unexpected results. The date of the appearance of the pustules belonging to the same species of rust varied considerably with the different cereals, and often even on the several lines or kinds of the same cereal, and upon sowings made at different times, although the seedlings might be growing side by side. The difference in the time of the outbreak of the same type of rust, such as black rust (*Uredo graminis*), was especially striking in the autumn and spring-forms of the same cereal, e. g. wheat, although these varieties were only a few metres apart.

At the same time that these observations were being made in the experiment field, very extensive infection experiments were carried out in the greenhouse. It was found that when growing in the experiment field rye attacked by black rust was unable to transmit this disease to either wheat or oats, even if cultivated side by side with them. Thus the form of black rust affecting various cereals would not appear to be absolutely the same. In the morphological species of *Puccinia graminis*, several biological races or specialised forms (*formae speciales*, f. sp.) are to be recognised; amongst these are found (in Sweden): 1) f. sp. *Secalis* on rye and barley as well as on certain other gramineae (*Triticum repens*, *Elymus arnarius*, etc.), 2) f. sp. *Avenae*, on oats and some other gramineae (*Dactylis glomerata*, *Alopecurus pratensis*, etc.), and 3) f. sp. *Trilici*, on wheat and occasionally attacking very slightly rye, barley and oats. Mention cannot here be made of the specialised forms of certain species of the genera *Ain*, *Agrotis*, *Poa*, etc.

It must, however, be admitted that the infection cultures made in the greenhouse did not explain all the unexpected results obtained in the experiment field. This is especially the case as regards the late appearance in summer and autumn of the primary pustules of various kinds of rust. The first pustules of black rust are seen — not counting outbreaks occurring in the immediate neighbourhood on the barberry — on autumn cereals in the middle of July, that is to say at least 9 to 10 weeks after the thawing of the plants which have over-wintered, and a week to a fortnight later, on spring cereals viz., 10 weeks after sowing.

It was observed at the same time that the primary rust pustules only made their appearance at the moment when the growth of the host-plant was nearly finished.

The differences in the first appearance and the vital force of the same form of rust in different years, were also remarkable and not easy to explain. An attempt was made to account for then by the dissimilar meteorological conditions existing during these years, but without success.

The fact that in the case of certain forms of rust — for instance *Uredo glumarum* — the uredospore production was enormous, whereas the germinating and infecting capacity of these spores were as a rule very slight, cannot

ious, and without any apparent effect upon the spread of the disease, also remained an inexplicable phenomenon.

All these observations taken together led the author to look for another source of the appearance and propagation of the disease viz., a disease germ present in the plant itself.

b) *Latent and Plasmic Life of the Fungi.*

"Die Getreideroste" (Stockholm) was published in 1896 and contained all the chief results of the new experiments that had been obtained up to the summer of 1894. Throughout the book, runs like a red thread, the idea of an internal disease-germ inherited from the mother-plant and in many cases causing the outbreak of the disease. This view was stated publicly and definitely for the first time, at the Annual Meeting of the Agricultural Academy of Sweden, on January 28, 1897, and was repeated subsequently at the "Académie des Sciences" of Paris on March 1, and at the German Botanical Society at Berlin on the 24th the same month.

The author had sought in vain to prove by microscopic investigation the presence of those internal disease-germs. He certainly discovered in the peripheral tissue of wheat seeds that had been shrivelled and deformed by yellow rust, a well-developed mycelium and sometimes even clusters of winter spores, but all attempts to find a mycelium in the embryo itself while still enclosed within the seed, or in the seedling, continued fruitless. It was only towards the time when the spots of rust began to appear, 1-8 weeks after sowing, that a mycelium of this character was to be discovered, and even then, it occurred only in the immediate neighbourhood of the spots.

The author then put forward the bold hypothesis that the fungus had hitherto led a latent plasmatic life within the protoplasm of the host, living with it in a state of symbiosis to which the author gave the name of *Myco-plasma*. At a certain time and under the influence of external agents, these two intimately united plants separate, and an intercellular mycelium which produces visible pustules of rust soon makes its appearance.

In the work "*Sur l'origine et la propagation de la rouille des céréales et la semence*" (*Ann. Sc. Nat.*, Paris, Ser. 8, Vol. 14-15, 1900-1901), a large number of experiments in support of the new theory are described. The author, however, not being entirely satisfied with the results of the isolated cultures made from 1892 to 1898, which a detailed account is given in the book, and realising that insurmountable difficulties might lie in the way of the solution of the problem by means of pure cultures made in special boxes and protected from external germs of disease, decided to employ the modern biological methods of fixing, mounting and staining certain parts of the organs attacked. At this time the author had the good fortune to have as his collaborator G. FISCHLER, now professor of Botany at Hohenheim (Württemberg) with whom the experiments were carried out in common during 1902 and 1903, and later by the author alone. The results of these

investigations are published in the series "Über das vegetative Leben d Getreiderostpilze (I-IV K. Vet. Ak. Handl. Stockholm, 1904-1905).

From a minute examination of microtome sections of the leaves autumn wheat, the pieces having been fixed and set in paraffin on October 6, 14 and 22, 1902, and April 22, May 29, June 5, 11 and 18, and July 1903, it was again clearly shown that there was no trace of mycelium which could explain the reappearance of the disease the following year. Descriptions and drawings were given of the different phases of the evolution of the intracellular mycoplasma as well as of the course of the fungus in the intercellular spaces. The different stages of the evolution of the intercellular mycelium up to the eruption of the pustules, were also described and figured.

The author's theory did not, however, meet with approval, as can be readily understood, for the new doctrine was contrary to all the dogmas of the text-books, and to the opinions of every lecturer on the nature and propagation of cryptogamic diseases generally. The new views were regarded as heretical from the beginning, and they were to be combated by every means, legitimate or illegitimate. The author has replied in a series of publications to all the criticisms advanced up to 1911, and has now in the press a book answering the criticisms made in recent years.

B. — THE RUST OF THE MALVACEAE.

Amongst the best-known species of rust there is one nearly resembling the rust of cereals, the *Puccinia Malvacearum* Mont. (rust of Malvaceae). Its resemblance to the disease of cereals led the author to study this fungus, and he has carried on his investigations from the beginning of the century *i. e.* for about 20 years. The results obtained during the first ten years are described in the book entitled "Der Malvenrost" (K. Vet. Ak. Handl. Stockholm, 1911), and he is about to publish shortly the results of the last ten years' experiments, in the work "Das Leben des Malvenrostpilzes (*Puccinia Malvacearum* Mont.) in und auf der Nahrpflanze (K. L. A. Handl., Bd. 62, No. 5). These investigations have proved that this fungus also has a mycoplasma stage. The origin of this plasms, that is to say, the entrance into the host-plant, has also been satisfactorily explained by these researches.

Proof has been given of the existence of two forms of spores similar from the morphological point of view, but differing biologically. One appeared a) on young plants of hollyhock that had just been raised viz. on plants in the autumn (September-October) of their first year, and b) on hollyhocks that had overwintered, viz., plants in the autumn (August to October) of their second year. These two forms of spores only occurred in hollyhocks belonging to a diseased line. The second form was called by the author *autumn spores*. The first appears some years in spring, summer, after a free interval of 3 to 6 weeks, in May and the last

ek in July, on plants that have over-wintered. These are the *summer spores* (1).

The *autumn spores* can germinate in two ways. If they find themselves immersed in water, for instance at the bottom of a drop of water, they germinate by putting forth long filaments which are at first slender and straight (Fig. 1 *a*, *a*₂), and later become curved at the tip (fig. 1 *b*₂). The minimal, very short articulations break up and form conidia (fig. 1 *b*₂).

If, on the contrary, the spores are situated on the surface of a drop of water, or in air saturated with water vapour they germinate by emitting short, broad promycelia curved at first (fig. 2 *a*) and bearing sporidia (fig. 2 *b*).

The *summer spores* on the other hand, always germinate — in water or in damp air — in the same manner, by putting forth long filaments and sporidia.

After inoculation, the sporidia send through the wall of the epidermis vesicular filament giving rise to a mycelium in the tissues, in the neighbourhood of the leaf, and after 10 days new spots of rust; the conidia discharge their contents in the form of a mass of plasm into cells of the epidermis in order as it would appear, to take entire possession of the leaf and there lead a mycoplasmatic life. After such an inoculation, no trace of rust pustules is visible for weeks.

In addition to diseased lines of hollyhock, there are also healthy lines that remain immune throughout the whole time of their growth. A healthy line can become infected if it comes up in spring or summer next to an infected one. A diseased line can however regain its health, if the vital energy of the fungus becomes exhausted.

C. — POTATO MILDEW.

Lit: J. ERIKSSON, *Développement primaire du Mildiou (Phytophthora infestans) au cours de la végétation de la pomme de terre*. *Rév. génér. de Bot.* Vols. 29 and 30. Paris, 1917-1918.

Since *Phytophthora infestans* Mont. invaded Europe, in 1845, there has been an annoying hiatus in our information respecting the life cycle of this fungus. The overwintering of the parasite and its reappearance in the potato-fields the following year are facts that have not been explained. About 1875, a great discussion arose on these subjects among scientists. Some investigators believed they had found in certain diseased portions of the plant oospores (resting-spores) of which the function was to insure the continued life of the fungus. Others on the contrary denied this explanation and maintained that the oospores which had been found did not belong to this fungus but were those of another peronosporacea belonging to the genus *Pythium*, their presence in the microscopic preparations being accidental. The German Professor, ANTON DE BARY, the

(1) Twice (1914 and 1916), the author observed that the production of autumn spores continued to the spring and throughout the summer of the following year.

most eminent mycologist of the day, was requested by the British Royal Agricultural Society to investigate the matter. In a work published in 1876, DE BARY pronounced in favour of the second opinion and his view was accepted almost universally.

It was clear that no light was thrown by this verdict on the re-appearance of the disease, but that on the contrary the solution of the problem was deferred until a distant future.

At the beginning of this century the study of the development of the disease entered on a new phase. In North America, and also in England, from 1904-1915, new and extensive researches were set on foot for the purpose of filling up the gaps that still existed in our knowledge of the disease, with a view to finding a better point of departure for its control. The chief method adopted in these experiments was the growing of pure cultures of the fungus from one year to the next on artificial media. In spite of every effort however the question of the over-wintering of the fungus still remained inexplicable.

In 1915, the author himself made this disease the object of the most careful researches. For the subject of his investigations he chose the spots of the primary disease (fig. 3), appearing in Sweden on the leaves of potatoes in the open field from the middle of July to the beginning of September, three or four months after the tubers had been planted. In 1905 and 1911, very small pieces of the rust spots and of the green tissue surrounding them as well of still healthy leaves, were fixed, embedded, cut and stained according to the ordinary cytological methods. The microscopic analysis of these preparations afforded very instructive results.

The first important discovery was of well-developed oospores (fig. 4b) in the withered or half-withered parts of the spots. These oospores were globular, 20 to 38 μ in diameter, and surrounded by a thick smooth membrane. They occurred either singly, or in groups of 2 or 3 in the remains of the spongy parenchyma of the leaf. Their formation is preceded by the fusion of a male organ (antheridium), and a female σ organ (oogonium) (fig. 4a). In sections containing these spores their germination could also be observed. These oospores germinate successively. They must not be regarded as resting-spores, for they are on the contrary true summer-spores.

In germinating, the spore, which is either undivided or differentiated into several portions, puts forth through the neighbouring stoma, one or more slender processes (fig. 4c), which will form the aerial mycelium and have the method of branching characteristic of *Phytophthora*.

In order to learn the true manner in which the fungus overwinters it was necessary to discover the origin of the primary mycelial filaments and for this purpose to examine all the zones of the leaf spot. This investigation gave positive results. In certain cells of the peripheral zone of the spot, a characteristic structure of the protoplasmic mass differing from the normal structure of the plasma was found. By the help of a high power of magnification, this plasma was seen to contain numerous minute black dots dispersed amongst the chlorophyll granules. In other cells of the

rious zones of the spot, and in the dark-green region surrounding it, the successive metamorphoses of the plasmic body could be followed, from the disintegration of the chlorophyll granules and the appearance of nucleoli, to the passage of the plasm through the cell membrane into the intercellular spaces of the tissue, there to form the primary mycelial elements. Some of the branches of this mycelium form antheridia and others oogonia.

In the author's opinion, there is no doubt that two different organisms are present in this plasmatic mass (one forming part of the plasm of the host and the other that of the fungus), in a condition of intimate and intimate symbiosis — the mycoplasm of the author.

By means of the researches just mentioned, the life-cycles of this fungus has been followed to its close.

It only remains to be discovered how the plasm enters into the mother-plant and lives there and whether a development more or less similar to that just described, but independent of it, takes place in the seed tubers during spring and summer. This is not improbable, seeing that the tuber is the organ by which the vitality, not only of the potato-plant, but also of the fungus parasitic upon it, is carried on from one year to the next.

D. — SPINACH MILDEW.

Lit: J. ERIKSSON, *Zur Entwicklungsgeschichte des Spinatschimmels* (*Peronospora Spinaciae* [Grew.] Laub). Ark. f. Bot. Vol. 15, Nr. 5. Stockholm, 1918. — Compare also: Rev. génér. de Bot. Vol. 32. Paris, 1920.

The disease of the spinach (*Spinacia oleracea*) caused by *Peronospora spinaciae* (Grew) Laub, has been known for over one hundred years. The spots of this malady appear some weeks after sowing and attain a fair size; they are irregularly distributed on the adult leaves. Their colour varies from white to yellow, and their lower surface is covered with a kind of bluish-grey felt. The spots spread rapidly, covering all the lower surface and killing the leaf.

The overwintering of this fungus is a much-discussed question, and many efforts at solution have been made without any satisfactory result. The authors' own observations, made during the course of many years upon the mode of appearance of the disease in different years, caused him to suspect that perhaps in this case also some plasmic symbiosis existed between the fungus and its host-plant.

During the summer of 1911, the author had the opportunity of making researches in this connection. At that time spinach was being grown at Experimentalfältet, Stockholm, on two small beds in the garden which were only 30 metres apart. Between these beds there were no trees or shrubs.

The first spots of mildew appeared on the plants of one of the beds on June 18, but the plants in the second were then apparently quite free from the disease. The author at once suspected that the plants belonged to two

different lines, the one diseased and the other healthy. On the same day pieces of leaves taken from the leaves of both beds, were fixed and embedded in paraffin.

The author's suspicions as to the health of the two kinds of spinach were found to be correct. After some weeks, all the plants of one bed were nearly dead, whereas the plants in the other remained free from disease until the seed ripened. Ripe seeds were collected from the healthy bed and sown the following spring in several different places. All the plants remained immune throughout the growth period. This admits of an easy explanation. The fact that the seeds of the two 1911 crops had been bought from different seed-merchants in Stockholm, would make it probable that they had different origins.

The microscopic investigation of preparations made from the two crops was very instructive.

In the first place it should be observed that there was not the slightest trace of mycelium to be discovered, either in the plants of the healthy line or in the apparently immune leaves taken from the diseased plants.

On examining the cell contents of the two lines however an essential difference was seen. *The cells of the healthy line presented a normal appearance* (fig. 5 a. b.), their protoplasm being relatively clear and transparent. *In the cells of the diseased line, on the contrary, the protoplasm was less clear and less transparent* (fig. 5 c).

By means of different staining methods and the use of the highest-power lenses, it was possible to distinguish in the cell content a fluid colloidal substance in which were embedded small bodies in the form of granules or little rods (fig. 5 d), resembling the Plastosomes, Mitochondriae, Microsomes, etc., of the zoologists. The chlorophyll granules of the diseased line differed also in their structure from those of the healthy plants, being less compact.

In the author's opinion, there is no doubt that the fluid colloidal substance with the granular and filamentous bodies it contains, is the *morphological system* of the stage of the disease to which he has given the name of *mycoplasm*. He was able to demonstrate the elemental structure of this stage of development for the first time by means of microphotography (2500)

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The first sign of the disturbance of equilibrium between the substance of the fungus and that of the host-cell, is the more or less complete disintegration of the chlorophyll corpuscles, which is succeeded by the nucleoli stage. From this time the fungus may be regarded as the victor in the duel between it and the cell. Symbiosis has now given place to *antibiosis*. This might also be termed the *mycoblastema* phase (fig. 6 a), that is to say, the independent plasmic stage of the fungus. The latter, which has hitherto led an intracellular existence, is now ready to escape from its captivity and enter upon its own life as a parasitic filamentous fungus invading the intercellular spaces.

Occasionally, quite young fungus-processes are also to be seen in the preparations. Two such formations, one belonging to either cell are visible in fig. 6 b. These processes take the shape of short wide *plasmic tubes*. Since the processes of several cells fuse on meeting, it may be concluded that these tubes are not surrounded by a definite membrane but by a thin film of plasm. In figure 6 c, the processes of two neighbouring cells are seen fusing in this way, growth continuing afterwards in the same manner as in the case of a single tube.

Once it has penetrated into the intercellular space, the fungus tube gradually develops to its full extent, and assumes the appearance of a thick mycelial filament. As in *Phytophthora infestans*, antheridia and oogonia are formed. A fusion of the contents of the male and female elements takes place resulting in the formation of oospores. The latter germinate directly, the aerial mycelium passes through the opening of the stoma. This marks the close of the vegetative period of the fungus.

E. — IS THE MYCOPLASMIC CONDITION A FAIRLY COMMON FORM OF EXISTENCE AMONG PARASITIC FUNGI?

In the preceding observations, the author has given as concise an account as possible of his careful studies of the following diseases; Cereal rust (*Puccinia graminis*, etc.), Hollyhock rust (*Puccinia Mahacearum*), Potato mildew (*Phytophthora infestans*), and Spinach mildew (*Peronospora Spinaciae*). These studies have led him to suppose that there exist in these fungi a method of growth of a plasmic nature within the host-plant, i. e. a symbiosis between the plasm of the parasite, and that of the host-plant; to this symbiosis he gave the name of Mycoplasm.

It is natural to ask whether this mycoplasmic mode of existence is peculiar to the diseases mentioned above, or if it is of fairly common occurrence in the plant world. A decisive answer to this question would necessitate new and profound studies of many diseases which are not yet sufficiently well-known.

Basing his belief on the observations he has himself made for many years, the author is disposed to suspect the existence of a more or less protracted mycoplasmic condition of existence in the following fungi: *Puccinia Chrysanthemi*, *P. Ribis*, *P. suaveolens*, *P. Tragopogonis*, *Uromyces Betae*, *U. Alchemillae*, *Cronartium ribicola*, *Phragmidium Potentillae*, *Phr. subcorticium*, *Coleosporium Campanulae*, *C. Compositarum*, *Chrysomyxa Abietis*, *Melampsora salicina*, *Peronospora Ficariae*, *Sphaerotheca mors-uvae*, *Sph. pannosa*, *Microsphaera Eonymi*, *Rhizoctonia violacea*, *Plasmodiophora Brassicae*, *Colletotrichum Lindemuthianum* and also in Tobacco Mosaic, etc.

F. — THE MYCOPLASM THEORY AND ITS PRACTICAL BEARING.

If the parasite is so intimately associated with the host-plant, as the Mycoplasm theory would seem to indicate, might it not be possible to use the latter as the basis for the effective control of these diseases? Could

not the vital energy of the fungus element of the mycoplasma be destroyed, or at least diminished, without affecting that of the host-plant? This is one of the questions which any investigator must put to himself, if he desires to combat the plant diseases which are such a constant source of havoc.

The author hastens to add that in view of our present knowledge on the subject there is every hope that such results are attainable. In support of this theory he brings forward certain observations made on Hollyhock rust (*Puccinia Malvacearum*), the results of cultural experiments made in 1912 and 1913, in which an attempt was made to hinder, by the addition of a fungicide to the water when watering, the growth of the fungus element of the mycoplasma that was dormant within the hollyhock.

The experiments were carried out in zinc cylinders, of which 10 were used in 1912 and 8 in 1913. These cylinders were 3 m. deep and 0.62 m. in diameter; they were buried in the soil of the experiment garden.

A. — 1912 Experiments. — On 3 May, 40 plants of hollyhock were dug up, and planted 4 in each cylinder. The plants belonged to a much infested line (rose de Chatel). The seeds had been sown in the summer of 1911. The young plants remained healthy until about August 15, but from the middle of September were badly attacked by rust. They were left in the open throughout the winter being merely covered with a layer of leaves and branches.

During the first 20 days the plants were given pure water as required. On May 23 the watering of the cylinders with a mixture of 1 % solution of copper sulphate began. The proportion of toxic salt was successively increased and in the case of certain cylinders reaches 10 parts per hundred.

On June 26, i. e. after 16 days, the first rust pustules made their appearance, although few in number, in eight cylinders. From this date all the leaves of the 40 plants were carefully examined and the extent of the disease in each case expressed as follows: 0 = absence of pustules, 1 = 10 pustules at most, 2 = up to 25 pustules, 3 = up to 100 pustules and 4 = over 100 pustules. At the same time, all the leaves were marked with spots of oil paint, so as to be recognised in subsequent examinations.

On comparing the plants in the cylinders during the course of the summer and autumn, a distinct difference was noted between those watered with water and fungicide solution respectively. On the first the amount

of rust rose slowly at the beginning $\frac{26}{6} - \frac{15}{7}$, then rapidly increased

$\frac{15}{7} - \frac{22}{7}$, reaching the third or fourth degree of the disease on a large

number of leaves. In the cylinders treated with the toxic solution on the contrary, the degree of rust intensity decreased, first rapidly and later more slowly. No new pustules appeared and the old dead sori became surrounded with black circles (fig. 7 b) showing that the mycelial tissue round them was dead.

B. — *Experiment of 1913.* — On 2 May, 32 plants of the same line of hollyhock were replanted in 8 cylinders, 4 plants being put into each cylinder. The hollyhocks remained immune until May 24, on which day a very small number of sori were discovered on the leaves of three plants. Watering with a fungicide solution began on June 4. Two cylinders were watered with pure water, two with 1 per cent toxic solution, two with a 1 per cent toxic solution at first and subsequently with a 2 per cent, 4 per cent, and finally 5 per cent solution.

The results of the experiments are given in the following table :

Immunisation Experiments carried out in 1913 at Experimentalfältet (Stockholm).

SERIES I: Pure water, 2 cylinders, 8 plants								SERIES II: Sulphate of copper (1 %) 2 cylinders, 8 plants							
Day	Number of leaves attacked by rust in degree					Dead leaves	Leaves total		Number of leaves attacked by rust in degree					Dead leaves	Leaves total
	0	1	2	3	4				0	1	2	3	4		
3.6	61	1	1	—	—	—	63		55	8	—	—	—	—	63
9—	45	15	2	1	—	—	63		46	13	2	2	—	—	63
18—	30	8	14	8	1	2	63		38	17	4	2	—	2	63
27—	21	6	8	21	2	5	63		37	15	4	2	—	5	—
4.7	21	5	3	21	6	7	63		43	7	—	—	—	13	63
25—	12	16	8	24	12	12	105		44	9	—	—	—	30	83

SERIES III: Sulphate of copper (1.3 %) 2 cylinders, 8 plants								SERIES IV: Sulphate of copper (1.5 %) 2 cylinders, 8 plants							
Day	Number of leaves attacked by rust in degree					Dead leaves	Leaves total		Number of leaves attacked by rust in degree					Dead leaves	Leaves total
	0	1	2	3	4				0	1	2	3	4		
3.6	59	3	—	—	—	—	62		63	3	—	—	—	—	66
9—	48	13	1	—	—	—	62		45	18	2	2	—	—	67
18—	47	10	2	—	—	3	62		49	12	3	1	—	3	68
27—	45	12	1	—	—	7	65		45	9	2	1	—	12	69
4.7	54	4	—	—	—	7	65		48	5	—	—	—	16	69
25—	53	26	—	—	—	21	100		52	26	3	—	—	35	116

Four days later, on July 29, a very considerable change was noticed. The plants in all the cylinders were seen to be attacked by rust in the highest degree and remained in that condition until the end of the experiment.

In his long memoir the author proposes to give a detailed account of the results obtained during his last ten years' researches on the rust of the Malvaceae, so he is here only concerned with this remarkable difference in the appearance of the fungus.

The results described above clearly prove that it is possible, by the introduction of a fungicide solution, into the host-plant, to destroy or at all

events to lessen the vitality of a fungus for a certain period of its life without in any way injuring the host-plant itself.

A toxic solution can greatly reduce, at least for a certain time, the destructive energy of the parasitic fungus. This fact provides us with new and *effective* weapons for combating plant diseases. It is true that so far the good effect of the substance used showed itself only during a certain period in the life of the fungus (June-July), and that this period was followed by another during which this favourable action was absent, so that the final result was not as satisfactory as might have been desired. All the same, however, *the discovery* must be regarded as *a great step forward*, and it must especially be noted, that the period in the life of the fungus when the efficacy of the fungicide was manifested, was the transmissible mycoplasmic stage of the parasite. The author sees in these results the prospect of successfully adopting a new kind of method in combating the diseases of cultivated plants. It is, however, certain that the theory of immunisation is not yet sufficiently advanced to be turned to practical account.

There still remains much to be done before such a treatment can be applied. In the case of a possible internal treatment, it would be necessary to experiment with different fungicides against various kinds of disease, and perhaps also to try therapeutic methods with serum, as adopted by doctors in the case of the diseases of man and the lower animals. In addition, it would be necessary, in given cases, to try external treatments with fungicide powders or solutions.

Naturally in such experiments there could be no question of watering entire fields, but only of treating a small number of plants of a certain kind raised in experiment gardens or green-houses, with the object of thus obtaining healthy seed.

For the carrying out of such experiments which are of paramount importance in order to increase the world's crops, the already-existing organisations — the Botanic Gardens of Universities and Agricultural Experiment Stations — are not sufficient, if it is desired to obtain, within reasonable time, results that can be turned to practical account. Certainly **it will be necessary to found one or more special International Institutes of phytopathological research** liberally provided with all the necessary equipment (laboratories, experiment fields etc.), where the most competent investigators of the various countries can carry on their researches. Such an Institute of Phytopathological Research could first be installed in Paris and annexed to the already existing Station of Plant Pathology.

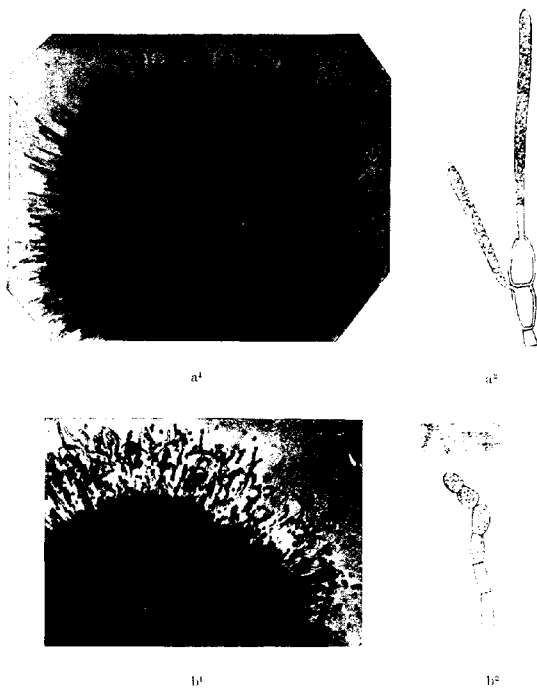


FIG. 1. — *Germinating spores with the aid of long filaments* — firstly (after 8 hours) erect (a1, a2), later (after 20 hours) curved at the end (b1) — and disintegrated in the form of conidia (b2).



FIG. 2. — *Germinating spores with the aid of short and long promycelia* (a) producing sporidia (b).



FIG. 2. — *Phytophthora infestans*. First appearance of the normal disease in the fields at the end of the summer (hence, a negative action; afterwards white spots).

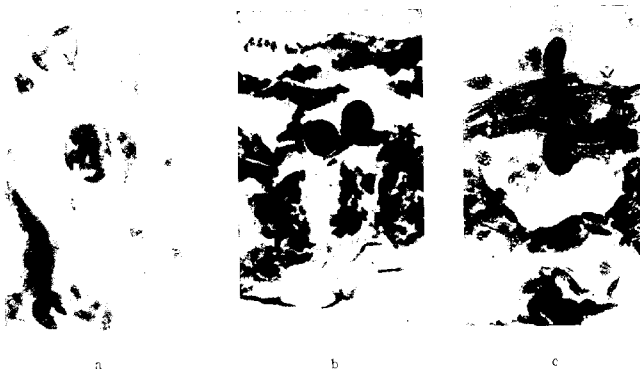


FIG. 3. — *Phytophthora infestans*. Foliage tissue broken up: a) zootheridium and oosonium ($\frac{1.50}{1}$), b) two mature oospores ($\frac{300}{1}$), c) a zoospore having germinated ($\frac{850}{1}$). (Microphotograph).

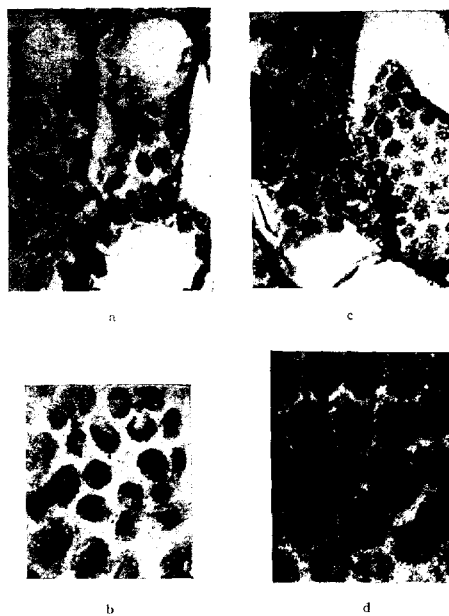


FIG. 5. — *Peronospora Spinaciae*. Healthy living spinach. a) group of foliage cells ($\times 1000$). b) group of chlorophyll cells ($\times 2500$). — Unhealthy living spinach. c) group of foliage cells ($\times 1000$). d) group of the contents of typical cells ($\times 2500$). (Microphotograph).

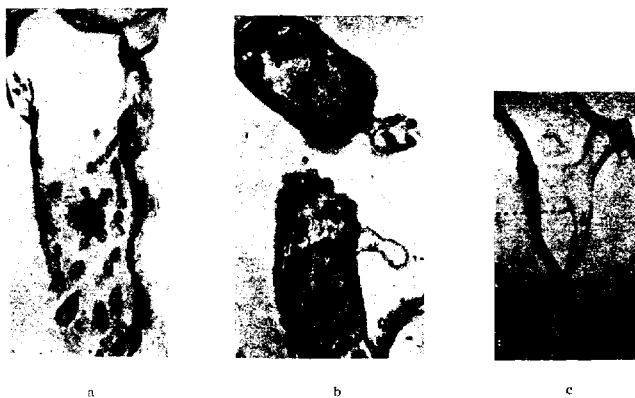


FIG. 6. — *Peronospora Spinaciae*. a) State of myceliastomose of the fungus ($\times 2500$). b) State of plasmatic disorganisation of the fungus ($\times 500$). c) The plasmatic channels of two adjoining cells are fused in a single tube ($\times 2500$). (Microphotograph).

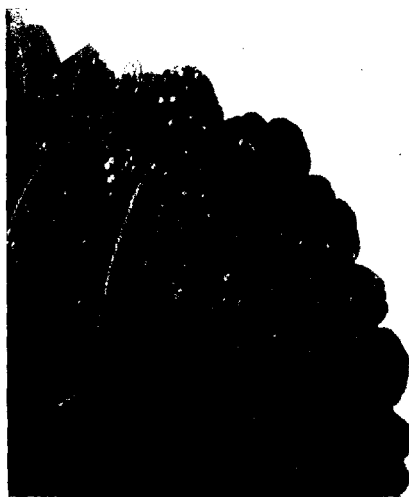


FIG. 7.

SECOND PART
A B S T R A C T S

AGRICULTURAL INTELLIGENCE

GENERAL INFORMATION.

- 25 - The New Bureau of Agricultural Economics and the Scientific Work of the Department of Agriculture of the United States. — WALLACE, H. C. (U. S. Secretary of Agriculture), in *Report of the Secretary of Agriculture, 1921*, pp. 16-27. Washington, 1921.

AGRICULTURAL
DEVELOPMENT

The Secretary of Agriculture of the United States being convinced of the necessity for devoting as much attention to the economics of Agriculture as to the encouragement of production, if agricultural crises are to be avoided, decided after consulting expert opinion, to unite into a single Bureau (that of Agricultural Economics) the already-existing Bureaux of Crop Estimates, and of Markets and Farm Management and Economics and to concentrate in one bureau all the activities of the Department which are devoted to the economic aspect of Agriculture. The purpose of this new bureau is to enquire into every economic condition and tendency which affects either production or price, for the one depends upon the other.

The first questions to be studied will be farm management, types of farming, cost factors and market grades and practices, so far as they bear on the management of the farm, the cost of production and distribution being also considered at each stage. Investigations will also be made in land economics with a view to encouraging the most economical methods of working; land resources and the best means of utilising them; land settlement and colonisation; the marketing of farm products with a view to an improved organisation of distribution; market conditions; standardisation and grading of products; collection of statistics of production and distribution; crop and live-stock production in the United States and other countries; prices of farm manufactured products; historical and geographical studies in production and distribution with a view to interpreting the trend of agricultural prices and production; the development or decline of markets and the general geography of the world's agriculture; methods of finance; insurance of buildings, live-stock, and stocks in storage; taxation and its relation to production and distribution; the financing of

[Abstract No. 225]

rural public utilities and other group enterprises ; agricultural conditions in countries which compete with the United States ; the characteristics and changes in rural home life and its relation to agriculture ; the trend of agriculture and population ; in short, everything that may assist the farmer along the path of scientific production. Such studies and investigation will be just as helpful to consumers as producers, for the ultimate purpose is to obtain an abundant supply of the products of the soil at prices which will support agriculture and be just to the consumer.

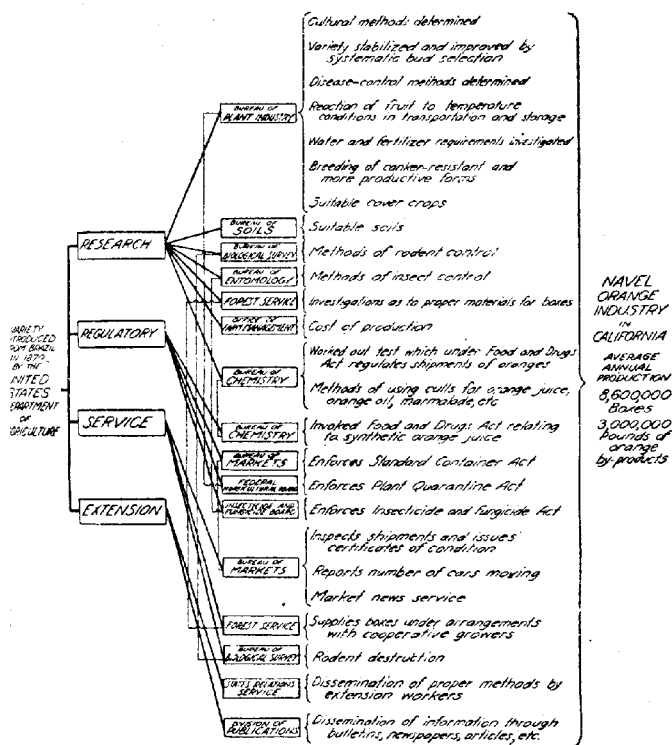
Much of this work is already in progress in the Department of Agriculture of the United States in accordance with the provisions of the organic law by which it was created in 1860. This department was charged with the duty of acquiring and diffusing "information on subjects connected with agriculture in the most general and comprehensive sense of that word."

The production of food has long been considered as an obligation, but it is no less an obligation to bring it to the consumer with the least possible waste and expense. Marketing is as truly a part of production as crop growing, for crops are of no value unless they can reach those who require them. The collection, storage and distribution of farm products require the same economic and technical knowledge as that needed by farmers. The acquisition and dissemination of knowledge of what to produce and how best to put it on the market so as to guarantee abundance of food at all times and at moderate prices cannot be gained from a study of marketing alone, but involve research in agronomic, biological, physical, statistical and economic science by men trained in their respective line and having a working knowledge of agricultural processes and conditions. In fact the knowledge of what to produce involves study of the varieties, qualities and quantities demanded by the market. In the case of fruit for instance, it involves the selection or the breeding of suitable varieties by the horticulturist, a study of life processes by the plant physiologist and the study of liability to attack by bacteria and fungi on the part of the plant pathologist. Practically all agricultural products are more or less perishable, and it is only by the co-operation of horticulturists, plant physiologists, phytopathologists, chemists, refrigeration experts and statisticians that it has been possible to give to American agriculture that distinctive character which makes it feasible to produce perishable commodities on one side of the continent and market them without serious deterioration on the other.

The accompanying chart showing the development of the Navel orange industry serves as a very good illustration.

In the marketing of grain, investigations are necessary on the milling and baking qualities of wheat and other grains, and for the purpose of determining the test weight per bushel, gluten content, colour, texture, general appearance, different forms of damage and adulteration to which grain is liable in handling. All this is necessary, not merely in order that the grain may be properly graded, but also that the most suitable kinds of grain may be bred, introduced and grown. This work has the profoundest

DEVELOPMENT OF NAVEL ORANGE INDUSTRY



effect on farm operations. The cereal breeders in the Department, especially those engaged in the breeding of wheat, work with those engaged in the studies of grain markets and standards. The closest collaboration is also necessary between the specialists of the Department, who are familiar with varietal adaptation and the rapid changes taking place in the varieties grown by farmers, and those persons who have to do with the market and particularly those concerned in formulating and administering grain standards. The rapid increase in the growth of red durum wheat made it necessary to introduce new standards for this class of wheat. Diseases play an important part in determining the market grade and value of cereals. The presence of smut for instance materially reduces the price of wheat and is always taken into account in grading. The shrivelling of wheat caused by rust and the presence of mouldy and rotten ears and spoiled kernels in maize due to rots and other fungoid diseases greatly affect their market value. Therefore the work of research specialists either in developing methods of controlling the disease, or in producing resistant varieties, is of importance not only to farmers, but to the grain trade and to consumers. It is necessary that the biological research workers should be in close touch with those who are studying grain-marketing and grain standards, so that the latter may be advised of outbreaks of new diseases or of the occurrence of already-known maladies. Crop rotation and farm management affect the purity of the products, and are therefore important factors in determining the grade of grain sold by the farmers. Practically every phase of research has its bearing upon marketing and benefits both producer and consumer.

Naturally, the basic work of the Department is in the field of research and it is upon the results of this work that its other activities are built. Of the 2500 different lines of investigation carried on in 1920, some of the most important may be mentioned : a new process for manufacturing phosphoric acid (without the immense waste in mining phosphates) and thus reducing the cost of fertilisers ; a method for separating the colloidal particles of the soil which is expected to throw light on such problems as cultivation of soils, the amount of water required by certain soils, their capacity for retaining plant foods and their reaction to lime ; the development of better methods for fixing atmospheric nitrogen for use as a fertiliser ; a soil survey that has completed the mapping of soils over an area of 1 063 588 square miles, including 31 915 square miles in Alaska and 300 square miles in Porto Rico, the work covering about 950 districts and 50 survey areas ; investigation of the rots of maize root, stalk and ear to determine the causes and methods of preventing these obscure and wide-spread diseases ; investigations of the effect of light and especially of the length of the day on plant development, furnishing explanations of phenomena in plant growth not previously understood but essential to accurate experimentation in the breeding of plants for economic purposes ; methods of accurate measurement of the productivity and other important characteristics of perennial plants, such as fruit trees, through bud selection which make it possible to replace undesirable trees by better types of the same variety.

ity; experiments for the purpose of improving the milking quality of cattle; completion of the establishment of a breed of general utility fowls laying white eggs; breeding experiments leading to the fixing of a type of American utility horse; studies to ascertain the cost of producing various farm crops, and the cost of marketing; studies to throw light on the whole marketing problem as a basis for the more efficient organisation of the various marketing processes, whether the work is carried out by individuals or by groups of farmers; research to determine the composition of agricultural products in order to develop more uses for waste and surplus crops; basic researches on the composition of foods and drugs in order to establish standards to prevent adulteration and to improve methods of manufacture; research to develop methods of chemical analysis for the use of chemists in Agricultural Colleges, Experiment Stations and those connected with Federal, State, and Municipal food and drug departments; the development of measures for the control of crop pests that have recently gained a foothold in the country; researches to determine the characteristics of materials intended for highway construction; researches to determine improved methods of highway design to meet modern traffic conditions; studies of hydraulic problems, including the factors influencing the passage of water in drainage canals.

It is impossible to estimate the value of this research work, but the money spent on it is capital invested by the Nation in building up a permanent agriculture. Its dividends come from increase in yields, decrease in cost of production and marketing and better utilisation of crops, all tending for their purpose the maintenance and increase of our food supply.

G. A. B.

26 - **The Present Position of Research in Agriculture in Great Britain and Suggestions as to the best Methods of Application to Practical Farming.** — I. HALL, Sir A. D. (Chief Scientific Adviser and Director General of Intelligence Department, Ministry of Agriculture), *The Present Position of Research in Agriculture*, in *Journal of the Royal Society of Arts*, Vol. LXIX. No. 3567, pp. 300-312. London, April 1921. — II. VOELCKER, J. A., *How Best to Utilise the Results of Agricultural Research in Practical Farming*, in *Journal of the Farmer's Club*, Pt. 6, pp. 109-129. London, Nov. 1921.

AGRICULTURAL
RESEARCH

I. — The organisation of research as applied to agriculture in Great Britain may be dated from 1909 when the Development Commission was established (1) and a scheme was formulated, dividing the field of research up by subjects and charging various Institutes with the fundamental research work for one particular branch, as a rule in conjunction with a University. This method was adopted in order to ensure concentration of effort, and to avoid overlapping and duplication and to give each Institute an opportunity to work out a continuous scheme of research and deal with the subject as a whole. Now that research is removed from immediate State control (apart from expenditure), the advantage of the association of the Research Institutes with the Universities has become evident, ensuring as it does informal co-operation with other workers in the

(1) See R. May 1913, No. 452. (Ed.)

field of pure science. Moreover the University which is teaching agriculture, comes into closer contact with the farmers in its district and much more so than a Government Department.

The Institutes that have already been established under the Scheme may be set out as follows :—

- 1) Soil and Nutrition of Plants, at Rothamsted Experiment Station, Harpenden (1).
- 2) Plant Pathology, at Rothamsted.
- 3) Animal Nutrition, at Cambridge and Aberdeen Universities.
- 4) Plant Breeding, at Cambridge and Aberystwyth (2).
- 5) Fruit Growing, at Long Ashton (Bristol) and East Malling (Kent).
- 6) Dairying, at Reading.
- 7) Plant Physiology, at the Imperial College of Science, London.
- 8) Agricultural Economics, at Oxford.

The Plant Pathology Institute at Rothamsted represents a combination of previous Institutes dealing separately with entomology, mycology and helminthology. The Staff is kept in daily contact with the workers upon soil and plant problems.

The two Institutes for Animal Nutrition are attacking different aspects of the same general problem. At Cambridge the Balfour Professor of Genetics receives a grant to carry out investigations into the laws of inheritance in animals which may prove of service in developing the science of breeding. The opinion is expressed that a wider scheme should be put forward dealing with Animal Husbandry as a whole including problems of a physiological character, etc.

The Plant Breeding Institute at Cambridge deals chiefly with cereals and other farm crops, and the Aberystwyth Station (2) with grasses, clovers, oats and fodder crops appropriate to the wetter climate of the west. In order to relieve the Institutes thus engaged in the work of commercial distribution, the National Institute of Agricultural Botany has been set up at Cambridge to receive new varieties of farm crops from the Plant Breeding Institutes and to grow and test on a large scale before putting on the market in commercial forms.

The two Institutes dealing with fruit problems work in very close harmony and represent different conditions of soil and climate as regards fruit growing in the eastern and western counties respectively. A small Experiment Station at Waltham Cross (under the general supervision of Rothamsted) deals with the problems of the fruit and vegetable grower who works under glass.

The workers on Plant Physiology at the Imperial College of Science are associated with the Fruit Growing Stations for the purposes of obtaining material and for the conduct of the field experiments required.

Two subjects have up to the present not received sufficient attention.

(1) See « Book of Rothamsted Experiments » by Sir A. D. HALL (Second Edit. Revised by F. J. RUSSELL), Murray, Albemarle St., London, 1919.

(2) See *R. Ang.* 1921, No. 868 (*E. d.*).

Firstly, diseases of animals :— It is considered desirable to set up an Institute for research into the comparative pathology of human beings and animals, with a view to obtaining results economically important both for the livestock industry and public health. Up till now the only work undertaken has been at the Research Laboratory at Addlestone, where certain questions specifically bearing upon the administrative work of the Ministry of Agriculture are investigated. A grant has also been made to the Royal Veterinary College for research work and recently to the London School of Tropical Medicine for investigations into the internal parasites of domestic animals.

Secondly research connected with agricultural machinery is of high importance. The future development of large scale agriculture depends greatly upon the application of machinery to farm work, and existing machinery probably requires certain radical modifications in view of the greater pace at which implements can now move because of the general introduction of mechanical power upon the land. Certain proposals in this direction are under consideration. The co-operation of the chief implement manufacturing firms must necessarily be assured.

Advisory Officers. — An essential feature of the Research scheme has been the further provision of a number of advisory officers attached to the various agricultural colleges, and relieved of their main teaching functions in order that they may give advice to farmers and horticulturists in their area, and conduct local investigations for their benefit. Eventually it is hoped to provide each college with 3 officers, as a rule a mycologist, an entomologist and a chemist, with modifications according to the special needs of the locality. Regular conferences are held between these officers, more especially the pathologists, directors of the related Institutes and the technical officers of the Ministry's Staff. In this way a systematic service is obtained to deal with plant pathology all over the country, which gives a general idea of prevailing conditions and furthurs the possibility of a combined attack upon any disease of widespread distribution. At the same time these officers serve as intermediaries between the Research Institutes and the farming public, on the one hand disseminating the results of practical importance, and on the other, advising the Institutes on problems that have been revealed locally, which may prove to be beyond the resources of the individual adviser.

MOST IMPORTANT PRACTICAL RESULTS WHICH HAVE ACCRUED FROM THE WORK OF THE VARIOUS INSTITUTES. — I. *Soils and manures.* — 1) Rich cake-fed dung must be got early on to the land, if great losses of nitrogen are to be avoided.

2) The most essential feature in the treatment of the ordinary dung heap lies in protection from washing by rain.

3) If crude sewage (1) be passed through a filter bed made up of straw, the straw will pick the soluble nitrogen compounds out of the

(1) The Sewage Sludge as Manure. See *R. Aug.* 1915, No. 793: *R. Sept.* 1920, No. 813. (*Ed.*)

sewage in order to start the humification process. Some 60 % of the nitrogen is removed from the effluent which becomes comparatively harmless, and the straw itself is converted into manure.

These conclusions were drawn after a series of valuable investigations carried out on the bacterial processes which bring about the making of farmyard manure, based on the discovery of a widely distributed cellulose fermenting organism, a *Spirochaete*, (1) by HUTCHINSON.

Further trials are in progress to enable market gardeners, etc. to obtain effective farmyard manure without depending on animals, a necessary step due to the present diminution of town stable manure.

II. — *Plant breeding*. — Of special interest is the fact that wheats have been produced which under East Anglian condition have added 10 % to the farm yield (BIFEN's experiments at Cambridge). Some of these wheats combine the "strength" of Canadian wheats with the English cropping powers.

Experiments are in progress to solve the problem of lodging in cereals.

III. — *Animal nutrition*. — A set of real growth curves is being obtained showing for each stage of the animal's development the relation between the food consumed, the live and dead weight, the useful meat and fat and the offal. (Investigations at Cambridge).

Investigations (at Aberdeen) into the vitamin factor in the nutrition of farm stock are leading to valuable results.

IV. — *Fruit growing*. — The confusion which has arisen from a mixture of stocks upon which fruit trees are grafted, leading to lack of uniformity of habit, etc. is being gradually righted, and it is now possible to work with true stocks for apple trees.

Research is also in progress on fruit preservation.

V. — *Plant diseases*. — Immunity rather than curative methods is the chief aim; the success so far obtained is evident in the case of the wart disease of potatoes (*Synchytrium solani*), immune varieties which will grow untouched in the most heavily infected soils having been discovered. (2)

VI. — *Economic investigations*. — The Research Institute at Oxford has started to work out methods for ascertaining the cost of agricultural production.

Special emphasis is laid on the fact that the State is getting value for its expenditure and that the majority of really fruitful ideas and conceptions that have recently become current in agricultural science have sprung from English laboratories. Attention is drawn to the fact that Rothamsted is at present undoubtedly the most completely and efficiently equipped agricultural laboratory in the world, and while the other Institutes up till now are on the material side inferior to Rothamsted, they all display an activity of mind and a fertility of invention and method that can be matched in no other country.

(1) See R. July 1919, No. 820, and No. 236 of this Review (Ed.).

(2) See R. Feb. 1914, No. 182, R. May 1918, No. 519; R. April 1920, No. 420 (Ed.).

EXPENDITURE. — The total funds set aside in the current estimates for research service amounts to £105 000 as compared with £38 250 for 13-14. It is interesting to observe the expenditure in the form of grants to Colleges and Institutions during the academic year ending September, 1920 :

a) Scientific Research and Experiment :	£
1) Capital expenditure (Statement A)	28 588
2) Maintenance Expenditure (Statement B)	52 470
b) Extension of Advisory and Local Investigation Work (Statement C)	13 798
c) Special investigations and researches not included above* (Statement D)	2 028
Experiments with Agricultural Machinery **	4 000
Miscellaneous Enquiries, experiments, etc.	1 500
Research scholarships **	1 900
	104 284

* Grants made to individuals in furtherance of approved schemes of investigation, tended for the benefit of teachers, etc. in Agricultural Colleges, Universities, etc. other than Research Institutes.

** Financial year ended March 31, 1921, estimated.

Details are given of the amount paid out under headings a, and b c.

It may be noted that the greater part of the expenditure goes upon the salaries of research workers and the State undertakes to provide the salaries with certain increments for a defined number of officers. This step has been taken in order to ensure that the general conditions are suitable for the highly trained University graduates who are best fitted for research work. The system of scholarships permits promising students to engage in research under the guidance of an Institute with a view to possible promotion.

II. — UTILISATION OF RESULTS OF RESEARCH IN PRACTICAL FARMING. — Dr. VOELCKER testifies to the value of the Universities, Colleges and Experiment Stations as sources of information, but devotes special attention to the methods so far adopted and others that might be employed for bringing the farmer into direct contact with these scientific teachings, always bearing in mind the somewhat conservative attitude of the farmer class with regard to science.

a) *Value of Agricultural Publications.* — These have accomplished a good deal, but seeing that the ordinary agriculturist is not a great reader and that many of the agricultural monographs bearing on practical problems are not readily understood by the farmer, it is considered advisable to introduce science into the ordinary school curriculum as soon as possible and thus pave the way to a clearer understanding.

b) *Value of Experimental Work.* — The importance of each station keeping in close touch with all other stations at home and abroad is emphasised (1) but the chief aim should be to give a clear interpretation of the

(1) "On the Continent, through the United States and Canada, also at centres in India and elsewhere, there are experimental and research stations each issuing regularly its report of work and in turn, keeping in touch with Rothamsted and other Stations. The work of

scientific discoveries and their practical bearing in order to allow the farm student to have a thorough grasp of the situation. Where practical experiments have been carried out on experimental farms run in conjunction with the various Colleges, and these have been made readily accessible to the farmer, distinct progress has been made.

c) *Agricultural Colleges and Farm Institutes.* — Apart from the Research stations mentioned elsewhere, opportunities for complete training in agricultural science are given to students and young farmers and in many cases provision is made for carrying on experiments on individual farms in the surrounding area. Among the best-known colleges are Armstrong College (Newcastle-on-Tyne), Leeds University, Harper Adams College (Salop), Midland Dairy and Agricultural College (Loughborough), the University Colleges of Aberystwyth, Bangor and Reading, and Wye College (Kent).

In addition to the more scientific instruction, there is a group of lower grade Institutes and Farm schools attended by persons who can only give part time to learning and are otherwise engaged in actual farm work. Here demonstration farms take the place of experimental farms, and a general teacher of science replaces specialised teachers of particular branches. The best known at present are the East Anglian Institute at Chelmsford (Essex), Marton (Rugby), Newton Rigg (Penrith), Sparsholt (Winchester) and Usk (Monmouth).

d) *Agricultural Organisers.* — The value of the services of the itinerant lecturer and advisor is fully acknowledged (see Pt. I).

From the results obtained up to the present it appears that before long a practical knowledge of the application of scientific discovery will be much more readily acquired to the ultimate benefit of agricultural progress.

M. L. V.

227 - Report of the "Imperial Economic Botanist" Pusa, India 1920-1921 with Reference to Wheat, Tobacco, Fibre Plants, Oil Seeds, Grain, and Indigo, including Physiological Investigations. — HOWARD, A., and HOWARD, G. L. C., in *Scientific Reports of the Agricultural Research Institute, Pusa, 1920-1921*, pp. 8-20, pl. II, bibliography of 7 works, Calcutta, 1921.

WHEAT. — The demand for botanically pure seed of Pusa wheats for trial in various parts of India including the Indian States, for starting new centres of seed distribution and for restocking old ones has been continuous. Special demands were made for Pusa 12 and Pusa 4 and a record has been kept of the progress made in the systematic replacement of the country wheats by these two varieties and in the first area selected, viz. the Central Circle of the United Provinces, it was decided to aim at the complete replacement of the country wheats of the alluvium by Pusa 12 and in the district of the Bundelkhand canals by Pusa 4 and to base the various distribution schemes on the central seed farm at Kailan-

these stations is regularly summarised in the "International Review of the Science and Practice of Agriculture" published by the International Institute of Agriculture, Rome. (Author's note)

11 (1). The aims and objects of the work and the progress made are expressed in concrete form, and a description is also given of the various unofficial methods of seed distribution which have been tried by the Agricultural Department.

The chief aim of the work done taken as a whole was to establish definite co-operative movement for the distribution of the improved seed and the consequent introduction of varieties superior to the local types hitherto cultivated. To attain this end, side by side with the various seed distributing agencies, the Agricultural Department has conducted a continuous series of village demonstrations.

The importance of strength of straw in wheat cultivation is well brought out in some wheat trials carried out by W. N. HARVEY at Gokharpur. Plots of Pusa 4 and the local wheat, 0.24 acres in area were sown in triplicate and the wheat was irrigated once. In spite of wind and rain in January which laid the local variety, Pusa 4 stood well till harvest and gave a yield of 29.50 maunds of seed per acre (1 maund = 82.28 lb.). The sparse foliage of Pusa 4 combined with the natural strength of its straw and its short growing period combine to make it a suitable variety for trials in intensive cultivation. A yield of as much as 40.75 maunds per acre has already been obtained on the large scale at Mangalghar (Bihar) under estate conditions.

One of the limiting factors in the growth of wheat in India is soil-temperature. It has however been reported by S. K. BASU, Deputy Director in Orissa, that varieties which mature with great rapidity, and require a short growth period can be matured in tracts where the cold season is too short for the ordinary crop. He recently raised a crop of Pusa 4 of over 18 maunds per acre on the rice areas in which the paddy crops had been destroyed by high floods the preceding July. The wheat was sown the first week in November and harvested early in March. These trials are being extended in new tracts.

With reference to water saving in wheat cultivation, the results obtained in North-West India are notified in *Bulletin 118 of the Agricultural Institute of Pusa* (reproduced from *Quetta Bulletin No. 4*).

Trials of the New Pusa Wheats. — One of the objects of this work is to obtain a bearded wheat with strong straw which will yield as well as Pusa 12 under cultivator's conditions. Pusa 54, giving an average yield per acre of 32 maunds, 34 seers and other types not yet tested at Kalianpur appear promising for this purpose, (when compared) with the average yield of Pusa 12, viz. 33 maunds, 8 seers.

Some of the Pusa wheats have evidently been found useful in breeding elsewhere. Prof. SCHRIBAUX of the Institut National Agronomique, Paris reported in June 1921 that by crossing the rust resistant Pusa 4 with Bordeaux, the hybrids obtained were clearly resistant to rust.

TOBACCO. — There has been an increased demand for type 28 from

(1) The present position of the work has been summed up in the *Agricultural Research Institute, Pusa, Bulletin No. 122*, by BURT, B. C., HOWARD, L. A., and HOWARD, G. L. C. (Ed.)

the Indian Leaf Tobacco Development Company and successful trials have been conducted recently at Guntur in the Kistna delta in accordance with the local demand for seed. In these experiments about 97 % of the plants lived when transplanted and gave a tobacco of very good colour, useful for cigarette manufacture. The Company is also undertaking trials of this variety in British East Africa, Kenya and Zanzibar. After providing for 50 000 acres this year, sufficient seed for 60 000 acres has been carried over for 1922 but the advance indents have already reached this figure.

FIBRE PLANTS. — A successful trial of the improved variety of "patwa" (*Hibiscus cannabinus*) (1) known as type 3 is reported by the South African Jute Company, Barberton, South Africa; the plants withstood drought, gave stems 10-14 ft. high, and a yield of fibre 35 maunds per acre on land freshly broken. (These trials are being continued on a larger scale). Type 3 has as a result been given a trial at Pusa and elsewhere, but only a small supply of pure seed has been so far maintained. It is expected shortly to be able to prevent natural crossing more easily and thus enable the extension of the crop areas.

Breeding work on roselle (*H. Sabdariffa* L.) discontinued in 1919 and 1920, has since been resumed.

OIL SEEDS. — Considerable progress has been made in the isolation and study of the unit species which make up the Indian linseed crop of commerce. Results are awaiting publication when the types have been repeated for detailed verification of the classification. The testing of some of the unit species has been started and is yielding promising results.

An exhaustive examination has been made in Great Britain of the commercial possibilities of safflower (*Carthamus* spp.) oil. The work has been carried out by S. S. REMINGTON at Aynsme, Grange-over-Sands, Lancashire who reports on its distinct economic value for colour, paint and varnish industries, for soap and linoleum manufacture, as well as for edible purposes and its possibilities for refining and bleaching. Further investigations are in progress on the proteins of the safflower seed and it is considered advisable to test the changes taking place in the oil under ozonisation, further weathering tests, etc.

GRAIN. — Some progress has been made in the testing of a number of promising types of grain. Large scale trials have been in hand with Pusa 17 and Pusa 18 which gave 21 and 22 maunds of grain per acre respectively. These trials were, however, interfered with by premature hot winds when the plants were in flower.

INDIGO. — Apart from the several publications issued recently on this subject (2) it is interesting to note that the authors' views on the impracticability of the improvement of Java indigo by chemical selection have been confirmed by an independent examination of the question

(1) For notes on *H. cannabinus*, See R. April 1918, No. 420; R. Feb. 1919, Nos. 141 and 1140. (Ed.)

(2) See R. Jan. 1922, Nos. 50 and 101. (Ed.)

by W. R. G. ATKINS (Indigo Botanist 1920). (See *Science Progress*, July 1921).

One interesting observation on the growth of Java indigo was made during the year which is worthy of record. In 1919 indigo was sown in an uncemented lysimeter with free drainage and splendid crops were obtained and no trace of wilt was observed (1). The stumps were left in the soil and two cuts were obtained the following monsoon (1920) after which a change took place in the physical condition of the soil, drainage became impossible and the plants died. In October 1920, the soil was removed from the lysimeter and at once replaced. Java indigo seed was sown the same day and up to the time of writing two fine healthy cuts have been obtained and the stumps are shooting again. This result appears to be directly opposed to the theory of phosphatic depletion, which has been advocated to account for the well-known difficulties in the growth of indigo in the Bihar soils. Here is a case where Java indigo has been grown for 2½ for 3 years in succession in a comparatively small volume of Pusa soil without any falling off in vigour.

PHYSIOLOGICAL INVESTIGATIONS. — Attention is at present directed towards the determination of the factors involved in the observed deleterious action of grass on fruit trees. A mass of results on this question has been obtained during the year which will shortly be published. Another subject under examination is the influence on growth of the various factors involved in poor soil aeration.

A result likely to prove of practical value has recently emerged from these investigations. During the rains of 1920 (a year of short rainfall), and in 1921 up to the end of August, it has been possible to preserve the lucerne crop and to carry it on successfully for two seasons by growing it on flat beds 3 ft. wide with irrigation furrows 1 ft. wide between the beds.

This method is now being applied to the growth for seed of crops like jute (or Sunn hemp *Crotalaria juncea*), safflower and Java indigo and it is considered likely to prove useful in the growth of jute seed in Bengal where similar monsoon difficulties exist.

A number of observations have accumulated also on the physiological aspects of disease resistance and on the conditions of the root system and of the soil which appear to precede infection by insects and fungi.

In 1921-1922, investigations on the lines indicated in the annual reports and in the publications of the Section, will be continued on the following crops — cereals, tobacco, fibre plants, pulses, oil seeds, fodder crops and fruit, and also on soil aeration and root development. M. L. V.

28 - The New Service of Agricultural Ecology in Italy. — *Nuovi Annali del Ministero dell'Agricoltura*, Year I, Part 2, pp. 395-398. Rome, December 1921.

By virtue of Law No. 500 of April 7, 1921, a new Service of Agricultural (Ecological) Meteorology was instituted. Its duties consist in the systematic study of the physical environment in which agriculture is

(1) See R. Oct. 1921, No. 1057. (Ed.)

practised with a view to determining by a well-defined method the principles governing the adaptation of crops to the climate of the different physiographical regions. These studies will at first be confined to such meteorological phenomena as have the most easily measurable effects, but later, with the co-operation of the Geological Bureau, the investigations will be extended to the agro-geological and topographical factors, in order to obtain a complete knowledge of the physical conditions under which farm-crops grow.

The new Service is sub-ordinate to the "Direzione Generale d'Agricoltura", Division IV) (Agricultural Instruction and Experiment), and consists of a Central Bureau of Agricultural Ecology and of several Ecological Stations.

CENTRAL BUREAU. — In addition to its directing and centralising work and the usual technical and administrative duties, the Central Bureau is also required to:

a) provide instruments tested by the Central Bureau of Meteorology and Geodynamics, in order that the meteorological observations may be perfectly comparable;

b) control the varieties from the botanical standpoint, so that the biological data may be comparable as far as possible;

c) make a comparative study of the thermic and hygroscopic properties of the soil in connection with this line of research.

d) collect the information and data supplied by the station; control and elaborate such information and data.

As the new Institute develops the Central Bureau will gradually assume the functions of a Central Experiment Station of Agricultural Ecology.

With the kind permission of Prof. Romualdo PIROTTA, the Bureau has carried out some experimental researches in the Botanic Gardens of the University of Rome; similar work is also being carried on at the Practical School of Agriculture of Rome.

STATIONS OF AGRICULTURAL ECOLOGY (1). — Of these there are three categories:

a) First-class Stations where parallel observations are made on the course of meteorological phenomena in the air and at various depths in the soil, and on the development of the plants and varieties according to the instructions received from the Central Bureau.

b) Second class Stations where meteorological observations in the air, and observations of plant growth are made.

c) Supplementary Stations. Here independent Studies are carried out without the aid of special instruments on the growth of plants and crop yield in connection with weather conditions.

At the present time these Stations are in direct communication with

(1) In order to form a network of these Stations the State Agricultural Institutes (Agricultural Colleges, Agricultural Stations, etc.) are being utilized and special Stations are in course of construction. (Ed.)

the Central Bureau to which all the data are sent. Gradually as the Directors of the First Class Stations acquire the necessary practice and experience for dealing with this branch of work, the stations will be granted a certain amount of autonomy and will themselves become Regional Centres having subordinate to them the Second Class Stations and the Supplementary Stations within their sphere of operations.

Registration of Observations. — For this, two kinds of form are used.

1) A form on which are entered parallel observations on plant-growth and meteorological conditions, determined objectively without instruments. On this form are noted the details (beginning and end), connected with the different growth stages; germination, tillering, heading, etc. In the case of each, the conditions affecting the plant positively or negatively are also entered.

2) Tables drawn up in the usual manner on which are registered the observations made with the help of instruments.

Utilisation of the Data. — By working up the data according to the method proposed by the Bureau, an accurate knowledge is acquired of the connection between a plant and its environment. In the first place the plant is analysed in order to determine, in each given case, the genetic factors or groups of factors governing the behaviour or reaction of the organism under different conditions of temperature, hygrosopicity, etc. noting the deficiency or excess. In the second place a careful examination is made of the environment as a function of the development and yield of the plant, in order to determine amid the complex interplay of the environmental factors, the value or the groups of values, exercising a dominant influence upon the yield, and to bring into prominence the characters of susceptibility and resistance to disease that are governed by the various genetic factors.

A sure basis is thus obtained for the direction of the operations undertaken to lessen the discrepancy between the plant and the conditions under which it grows.

Thus in the case of wheat, definite information is obtained on the following points :

1) Which among all the varieties cultivated in or suitable for introduction into a region is the most suitable for any given locality.

2) The best dates for sowing, so that the times when the plant is most susceptible may coincide with the most favourable periods.

3) The best cultural operations and the most suitable time for carrying them out, in order to counteract the negative action of unfavourable meteorological conditions.

4) These data are also used to direct the breeder who is anxious to unite in the same individual, and in definite proportions so as to obtain the maximum yield, the two characters, specific productivity and resistance to the most dangerous and injurious meteorological conditions.

In short a decrease in risk (as regards weather changes) is thus effected and hence an increased yield without useless outlay, which means a real increase in the value of the capital.

Such systematic and continuous work has to be pursued for a long time

before yielding averages of any value. This branch of work is common to all the Stations, but the Central Bureau recognises the importance of combining general research work with the study of local problems and has directed the different Stations to investigate the difficulties that arise in their immediate neighbourhood.

Since 1919, under the auspices of the Società degli Agricoltori italiani (now the Istituto Nazionale d'Agricoltura), the Director of the Service has been engaged in drawing up a biological census of wheat (1) and has sent the following list of questions to the Directors of all the Agricultural Institutes of Italy.

- 1) What meteorological conditions are injurious to wheat? State in the case of each at what time in the growth period of the plant it occurs, and the number of times in a decade.
- 2) What are the fungoid diseases and other causes of reduced yield of which the appearance and development are closely connected with the state of the weather?
- 3) What varieties of wheat are cultivated? State in the case of each:
 - a) The area occupied in % of the total area under wheat;
 - b) If this area tends to increase or diminish, give the reasons;
 - c) How does the wheat behave under unfavourable meteorological conditions.

Useful replies to these questions were given in 194 cases.

The material thus collected will not only furnish data for a monograph on climatic conditions of wheat-growing in Italy (which is soon to be published) but, after the necessary tests have been made and the results verified, will show, in the case of each district, the most important meteorological problem which must be investigated and explained without delay.

The Ecological Station have therefore a twofold object:

- 1) *general* (the systematic study of the environment).
- 2) *special* (the study of local problems).

* * *

The Bureau will publish synthetically all the results obtained, and will send all information and suggestions of a useful and practical character to the following Institutions:

- 1) Agricultural Experiment Stations' and "Cattedre ambulante d'Agricoltura" (in the case of all questions connected with the choice of varieties, the optimum date for sowing and for other operations).

(1) By the Decree under date of February 20, 1920, this census is extended to all the wheat-growing countries and the data thus obtained will be used in the preparation of a general monograph on the Climatic conditions of Wheat-Growing. (Ed.)

2) Institutes of Genetics and Phytotechnical Stations. These will receive:

a) An account of the researches undertaken for the purposes of determining accurately the physiological region where a new variety can be introduced with success;

b) All ecological data that will guide students of heredity in their researches as far as the conditions of the physical environment are concerned).

3) Bureau of Irrigation (information regarding the dates when irrigation is necessary).

4) Bureau of Statistics (scientific explanation of statistical data).

5) Institute of Plant Pathology (the Bureau will furnish the data required for organising the control of those insect and fungoid diseases whose appearance and development are clearly correlated with weather conditions).

G. A.

CROPS AND CULTIVATION

29 - Experimental Researches on the Critical Period of Wheat, as Regards Rainfall in Italy. — Azzi, G., in *Nuovi Annali del Ministero per l'Agricoltura*, Year 1, No. 2, pp. 299-307. Rome, December 1921.

AGRICULTURAL
METEOROLOGY

The results of a series of experimental researches on the critical period of wheat as regards the heading stage, and on the behaviour of the 4 varieties employed.

These experiments were carried out during the agricultural year 1920-1921, at the Botanic Garden of the University of Rome.

MATERIALS AND METHOD. — Varieties of wheat examined: *Apulia* Rieti × *Spelta*, *Cervaro*, *Carlotta Strampelli* (Rieti × *Massy*), seed supplied by M. STRAMPELLI, and *Spelta*, seed supplied by MM. ANDRIEUX-ILMORIN.

The fact that one variety, unlike the others, does not suffer from injuries due to drought may be due to various causes:

1) The heading is early or late which displaces the critical period, so that the drought occurs at a time when the plant is less susceptible to its effects.

2) The roots penetrate deeply, thus allowing the plant to draw water from the supplies that have accumulated in the lower strata of the soil when rain is absent, and the surface is insufficiently damp.

3) The plant's structure is such as to enable it to economise water and thus attain the same results (straw and grain production), with less water consumption. This is true drought resistance, and is the object of this work.

The plants were grown in pots filled with the same kind of soil, and were kept under cover in a movable shed during the critical period.

There were for each variety, 20 pots divided into 4 lots or series: 1, B, C, and D.

All the pots without distinction were watered copiously from Dec-

ember 29 to April 12 (1st sub-period), and from the 7th day after heading until maturity (2nd sub-period), and therefore did not suffer from any lack of moisture.

In the interval (2nd sub-period) from April 12th to the 6th day after heading (when it is to be supposed that the effect of moisture would be most noticeable), the series *A*, *B*, *C* and *D* were subjected to different treatments.

Series *A* was watered 3 times on May 5, being given 45 mm. each time, and twice on May 8 receiving 30 mm. each time.

Series *B* was given 30 mm. of water twice on May 5.

Series *C* was given one watering of 15 mm. on May 5.

Series *D* was not watered at all.

Pot experiments have many drawbacks, but in the present case they have the advantage of limiting the study to a great extent, and confining it to the question of real drought resistance, by suppressing the effect of root-penetration and of the date of heading.

RESULTS. — The amount of water placed at the disposal of the plant affects the date of heading in so far that the latter is retarded in proportion as the conditions of the environment become worse.

The following phenological data were obtained :

Varieties	A	B	C	D
Cervaro	May 9	May 10	May 13	May 18
Apulia	» 13	» 15	» 17	» 18
Spelta	» 18	» 25	» 28	June 1
Carlotta Strampelli	» 20	» 20	» 21	May 28
General average . . .	May 15	May 17	May 20	May 24

This progressive retardation even if it were also to occur under normal conditions in the case of farm-crops, could not fail to have a deleterious effect, as it would induce late maturity in the plants; ripening took place in fact at the same time in all the series, the order being as follows: Apulia, Cervaro, Spelta, Carlotta Strampelli. From the beginning of maturation, the difference between the watered and unwatered plants manifested itself very clearly. The latter developed badly and remained very low; the ears scarcely emerged from the foliar sheath; heading was incomplete and even entirely absent in some individuals.

In the Apulia variety the tendency to shrivel up, manifested by the leaf-blades was noticeable, some becoming almost spike-like in shape (in the series *C* and *D*), which reduced the respiration surface.

All the plants gathered were biometrically examined with regard to the following characters: length of culm; weight of culm; length of ear; weight of ear; number of grains per ear; weight of grains per ear; weight of each grain; weight of rachis. All these characters are pos-

ively associated with the straw length, and should vary according to the same rules.

The author has limited himself to giving the data that are absolutely necessary for the purpose of demonstration. In the Tables the numbers marked with an asterisk represent values lower than those calculated, probably due to the difficulties experienced in maintaining absolute uniformity of conditions in all the pots.

In estimating the data and the harvest, the twofold object of the work must never be lost sight of:

1) The experimental proof of the existence of a critical period for wheat as regards rainfall at the heading stage;

2) The special behaviour of the 4 varieties examined.

As regards the grain yield, its direct relation with the rainfall during the critical period was clearly shown; increasing the watering also increased the weight of the grain borne by each ear. On taking the average of *A*, *B*, and *C* and comparing it with *D* the difference between the watered and unwatered plants is still more striking (See Table I).

The 4 varieties may be divided into a 2 lots according to their special behaviour: Cervaro and Apulia most drought-resistant, and Spelta and Carlotta least drought resistant.

1) *Spelta and Carlotta*. — The yield of the unwatered pots was very scanty; if the amount of water is increased, the yield also increases rapidly and the difference between the two lots, the unwatered and the watered, which can be expressed by the quotient obtained by dividing the average of *A*, *B*, *C* by *D*, is very high: Spelta = 2.6; Carlotta = 3.0.

2) *Cervaro and Apulia*. — The return, even from the unwatered pots, is relatively high — 3 to 4 times more than in the case of Carlotta and Spelta. With the progressive increase of the amount of water placed at the disposal of the plant, the increase in the weight of the grain is less rapid than in the preceding case, and the difference between the average of *A*, *B*, *C* and that of *D* is somewhat slight. In fact, the quotient is reduced to 1.1 and 1.2 for Cervaro and Apulia respectively. Similar conditions are found again as regards the weight of each seed; this can be also considered as an index of the quality of the product (see Table III). In Carlotta Strampelli, there is a regular, ascending curve from *D* to *A*. Thus, *D* = 1.5 cg; *C* = 1.9 cg; *B* = 2.6 cg; *A* = 3.0 cg.

The straw yield, both from the standpoint of the weight and the length of the culms, confirms as regards the existence of the critical period, what has already been observed in the case of the grain: the weight and length of the culms increases with the increase in the amount of water given (see Table III). Cervaro gives the most regular curve: *D* = 53 cm.; *C* = 61 cm.; *B* = 74 cm.; *A* = 77 cm.

In series *D*, the difference between the Cervaro-Apulia group and the Spelta-Carlotta group is very great (Cervaro = 53 cm.; Apulia = 53 cm.; Spelta = 36 cm.; Carlotta 35 cm.) and it remains the same, unlike what has been found in the case of the grain; this also applies to the 4 varieties (from 1.4 to 1.5).

The correlation between the length of the ear and the amount of water given during the critical period, is on the contrary a little less close, in spite of the positive connection between the length of the culms and the length of the ear. The correlation coefficient for Apulia is almost reduced to zero: in the series *D*, the length of the ears is almost the same as in series *A* and is greater than in *B* and *C*. This capacity of reducing the growth of the culm, under unfavourable conditions without shortening the ear might be interpreted, given further verification, as a character of adaptation to drought.

As regards the characters: weight of ear, number of grains per ear, etc. which are positively correlative with straw length, the same general observations hold good as those made in the case of straw length.

GENERAL CONCLUSIONS. — 1) The existence of a critical period (occurring in the interval between the 6th day before heading and the 6th day after the appearance of the ear), is entirely confirmed by these experiments. The straw length and all the correlative characters are increased (rise in value) with the increase in the amount of water placed at the disposal of the plant during the critical period.

2) The four varieties of wheat examined can be divided into two groups according to their behaviour as regards the above-mentioned phenomena:

A) Apulia and Cervaro, more resistant to drought.

B) Spelta and Carlotta, less resistant to drought in the following order: Cervaro, Apulia, Spelta, Carlotta. This order may however, be somewhat modified by the further experiments in progress: the growth of the plant and its grain yield also depend upon the specific productivity of each variety, which has not yet been accurately determined.

3) The actual productivity of a plant is the result of a compensation established between specific productivity "and resistance to the most injurious environmental factor."

The productive capacity usually decreases with the increase in vigour; hence, a plant that is very resistant to drought and unfavourable meteorological conditions, even if provided with the best environment for its development, always gives a relatively low yield.

On the other hand, a vigorously growing variety bearing large ears (high specific productivity), but not possessed of the necessary drought resistance, when placed in dry surroundings does not develop at all, or only produces seed that cannot set. Of this Carlotta Strampelli is the typical case; this wheat is also endowed by heterosis with a high specific productivity that manifests itself with the progressive improvement of the environmental conditions. On the present occasion, the plant did not succeed even when watered 5 times, in completely filling the grains which still remained shrivelled.

Spelta is certainly possessed of a much lower productive capacity.

As for Cervaro and Apulia, there are not enough data to be able exactly to estimate their xerophily: even from observations made during the vegetative period, Apulia seems to have very distinct capacity for adapta-

ing itself to a dry climate; the greater productivity of Cervaro might therefore be attributed to a greater specific productivity which is however always below that of Carlotta, and ran no risk of being impaired by the lack of moisture to which it was subjected in the course of the experiment.

In Cervaro it would appear that specific productivity and drought resistance are united in the best proportions.

TABLE I. — *Weight of Seeds per Ear in cg.*

Varieties	Number of waterings					Difference between watered (a) and unwatered plants (s)	$\frac{a}{s}$
	0	1	2	5	$\frac{1+2+5}{3}$		
Cervaro	53	47	66	73	62	9	1.1
Apulia	39	46	30	65	47	8	1.2
Spelta	13	26	37	30	34	21	8.6
Carlotta Str. . . .	14	33	50	46	34	29	3.0
General average	26	38	46	54	46	17	—

TABLE II. — *General Averages for the 4 Varieties of Wheat.*

	Number of waterings					Difference between unwatered and watered plants
	0	1	2	5	$\frac{1+2+5}{3}$	
Weight of seeds per ear in cg. . . .	29	38	46	54	46	17
Average weight of each ear in cg. .	2.17	2.50	2.47	3.10	2.70	0.53
Length of culm in cm.	44	56	60	64	61	17
Length of ear in cm.	6.6	6.6	7.2	7.9	7.0	0.4

G. A.

230 - **Evaporation and Other Soil Properties found to be Connected with Soil Constitution.** — I. KEEN, B. A. (Goldsmiths' Company's Soil Physicist, Rothamsted Experimental Station), The Evaporation of Soil. Influence of Soil Type and Manurial Treatment, in *The Journal of Agricultural Science*, Vol. XI, Part. 4, p. 432-440, figs. 2. Cambridge, October 1921. — II. KEEN, B. A., and RACZKOWSKI, The Relation between the Clay Content and certain Physical Properties of a Soil, *Ibidem*, pp. 441-449, Figs. 5.

In an earlier paper (1) the author had shown that the essential difference in the evaporation from sand and soil was primarily due to the colloidal portion of the clay fraction in the soil, and secondly, to the organic matter present. The experiments now described were carried out on two soils,

(1) See R. 1915, No. 248. (Ed.)

one of which contained about 6 % of clay, and the other 15 %. In order that the influence of manurial treatments could be studied at the same time, samples were taken of each soil from the unmanured plots, and plots given farmyard manure, and complete artificial manure, respectively. The rate at which the soils lost water over concentrated sulphuric acid and at a constant temperature, was found to depend firstly, on the amount of clay present, and secondly on the amount of organic material in the soil. The differences due to content of organic material were more obvious in the soil containing the larger amount of clay, the farmyard manure plot lost water at the slowest rate and the unmanured plot occupied an intermediate position.

In the sandy soil, the differences in evaporation due to manuring were small.

There is evidence that the moisture equivalent of these soils, measure the percentage of water at which the evaporation is first directly affected by the soil particles and that, at percentages of water in excess of the moisture equivalent, evaporation is taking place substantially from a free water surface.

II. — It is well known, that the behaviour of most soils, is largely determined by the percentage of clay they contain; for this reason the authors proposed to measure various fundamental properties of a given soil (such as pore-space, apparent and real specific gravity, volume, expansion of soil when saturated) at different depths and as affected by the clay content.

The results obtained showed that the weight of unit volume of air dry soil, viz., its apparent specific gravity, and its real specific gravity, varied inversely with the percentage of clay in the soil, whereas the amount of water it takes up, pore space and volume expansion when saturated varied directly with the clay percentage. The effect on the constants of the larger quantities of organic matter present in the top two layers of soil of 15 cm. and from 15 to 30 cm. was, weight for weight, approximately equal to that of the clay, except in the volume expansion results where the effect, if any, was within experimental error. It is possible that a fine silt fraction with an upper limit of diameter of 0.005 mm. may have similar effects to the clay fraction.

G. A. B.

231 — **The Chlorine Index as a Comparative Measure of the Nitrogen Content of Soils.** — VEIL C., in *Comptes rendus de l'Académie des Sciences*, Vol. CLXXIV, pp. 317-319, Paris January 30, 1922.

Hypochlorite of sodium when in contact with arable soils, loses its active chlorine. It has been shown that the amount of chlorine which thus disappears is connected with the humus content and affords an index of the probable fertility of the soil (1).

The author adopted the same method in order to discover whether any correlation exists between the chlorine index thus determined and the nitrogen content. He investigated the connection between the amount

(1) See R. 1919, No. 424. (Ed.)

of chlorine in the soil (cm^3 per cm^3), and the nitrogen present (gm. per 100 dry weight), using for the purpose soils for which, as far as is known, no chemical fertilisers had been used. A certain number of samples came from the neighbourhood of Paris, others from Brittany, Haute-Marne and Morocco; there were 20 in all.

Generally speaking, the higher the chlorine index the greater the nitrogen content of a soil. Three classes can be clearly distinguished:

- 1) Very rich soils, where the nitrogen content is above 4 per 1000 and the chlorine index higher than 30.
- 2) Soils with a low humus content, where the nitrogen content is above 1 per 1000 and the chlorine index varies between 7 and 12.
- 3) A series of soils of average richness, with a nitrogen content varying between 15 and 27, and chlorine indices above 1 per 1000 and below 2 per 1000.

G. A. B.

232 - **Researches on the Presence of Arsenic and Iodine in Soils and Subterranean Water in Argentina.** — I. RIECHERT, F. TRELLES, R. A. (Laboratorio Químico de Investigaciones Agropecuarias, Facultad de Agronomía y Veterinaria, Universidad Nacional de Buenos Aires). Sobre la presencia del arsénico como elemento normal en las tierras vegetales, in *Revista de la Facultad de Agronomía*, Vol. III, Part 3, pp. 281-284, 1 pl., bibliography of 9 works, Buenos Aires, December 1927. — II. IDEM, Iodo y arsénico en las aguas subterráneas, *Ibidem*, pp. 285-287, 1 fig., bibliography of 12 works.

The classical researches of GAUTIER have proved that arsenic is normally present in the animal organism; JADIN and ASTRUC have shown that this arsenic comes from vegetable foods, and as the plants consumed must obtain their supply of this substance from the soil, it is necessary to determine the arsenic content of the latter.

For this purpose the authors analysed the Argentina plant products. Arsenic was always found in the latter, but in smaller quantities than had been observed in Europe, except in the case of the seeds for instance of wheat grain harvested in regions where the soils are rich in arsenic. The authors analysed 20 different soil samples and found the arsenic content varied from 0.08 mg. to 2.25 mg. for 100 gm. of air-dried soil; it was not possible to determine the relation between the amount of arsenic and iron present, but it was found that arable soils always contained arsenic and that there was no connection between their chemical composition and their arsenic content. The latter is highest in the upper layers and decreases with the depth.

Although there is no general rule, it appears possible that some connection may exist between the amount of arsenic in the soils and in the subterranean waters beneath them, as has been observed in an arsenical district (North Santa Fé).

It should be remembered that iodine and arsenic are constantly present in the waters of the pampas, their amount depending on the chemical composition of these waters, and on the geological nature of the soil. Water containing chlorine, sulphur and sodium bicarbonate have the highest iodine and arsenic content, while those coming from granitic or calcareous soils have the lowest. The iodine may be derived from marine deposits,

but it must not be forgotten, that it is of constant occurrence in soils, atmospheric dust and freshwater algae, and also that all other plants are relatively rich in iodine, as has been shown by the researches of GAUTIER and others.

G. A. B.

- 233 - **Concentration of the Hydrogen Ion in the Soil and in Plants.** — I. ATKINS, W. R. G., Some Factors affecting the Hydrogen Ion Concentration of the Soil and its Relation to Plant Distribution, in *The Scientific Proceedings of the Royal Dublin Society*, Vol. XVI, n. 4, Nos. 39-34, pp. 369-423. Dublin, 1922. — II. IDEM, The Hydrogen Ion Concentration of Plant Cells, *Ibidem*, p. 414-426. — III. IDEM, Note on the Occurrence of the Finger and Toe Disease of Turnips in Relation to the Hydrogen Ion Concentration of the Soil, *Ibidem*, pp. 427-434, bibliography.

I. — The author gives a critical review of the literature dealing with the concentration of the hydrogen ion in the soil, and the factors exerting an influence upon this concentration and its relation to plant distribution. He reaches the following general conclusions.

In the first place it is desirable, in order to determine the fundamental relations existing between the ions present in the soil solution and its hydrogen ion content, to consider separately the effects of the different salts. When water is in contact with pure calcium carbonate the theoretical maximum alkalinity is only pH 9.01 (1) which may be attained experimentally in the absence of carbon dioxide. The corresponding bi-carbonate in equilibrium with the gases of the atmosphere is pH 8.37 at 16° C becoming more alkaline at higher temperatures. Owing to the high content of carbon dioxide in the soil, the pH values of limestone soil are usually lower and they vary with the aeration.

The theoretical maximum alkalinity for magnesium carbonate is pH 10. Dolomite soils may thus attain to greater alkalinity than limestone soils. Alkalinity of over pH 10, due to sodium carbonate, may be reduced to pH 8 by the addition of calcium sulphate. The former reaction is injurious or destructive to plant cells, whilst the latter is favourable to most plants.

Soil acidity may be occasioned by the oxidation of sulphur from iron pyrites. This acidity favours the production of available phosphate and is accordingly beneficial to certain plants. Owing to production of carbonic acid by bacteria, a soil extract may decrease in alkalinity from pH 8.7 to 7.2 or less; the result in the soil appears to be to render iron salt more readily available in calcareous soil when inundated, than when uncovered. The alteration is usually more rapid in soils from the 6 to 6 inches than at greater depths.

Continuous manuring with sulphate of ammonium or of potassium decreases the effective soil alkalinity, even in a calcareous silt, but by small amount only, about pH 0.2-0.4 in the cases examined.

An acid soil extract is only slightly altered by boiling; in one instance from pH 5.4 to 5.7. Alkaline extracts tend to reach the maximum value for calcium carbonate pH 9.0. Higher values, such as pH 9.2, appear to indi-

(1) See R. February 1910, No. 159. (Ed)

cate the presence of magnesium in small amounts. The altered reaction is probably of importance in inhibiting the growth of certain soil organisms in heated soil.

When arranged in order of decreasing alkalinity, soils derived from different materials stand as follows: — calcareous silt, limestone, sandstone, calcareous tuff (schalstein) with slate, ordinary state, pillow-lava (spilite), felsite and granite. The values are modified in certain places, for proximity to the coast lessens acidity and a high gradient often increases it. The results relate mainly to Devonian strata and the accompanying volcanic or plutonic rocks.

The author gives figures for the hydrogen ion concentration of the habitats of over a hundred native plants. These show that the measurement is a valuable index of various soils conditions and that many plants are limited to a short range of pH values; others with a wider range occur within certain definite pH values, but some plants grow well at widely different soil reactions. A distinction must be made between acid peaty soils, acid clay soils and acid sandy soils. It is interesting to note that wild flowers grown in a garden, do best when the soil reaction is similar to that in their native habitat.

Natural waters, even from the peaty districts examined, contain no acid other than carbonic. Water in a spring may be at pH 6.4 and the stream flowing from it at pH 8.3 when in equilibrium with the atmospheric concentration of carbon dioxide. Photosynthesis may raise water containing magnesium salts to pH 9.7. The hydrogen ion concentration of natural soft waters, tends to increase during winter and to decrease in summer.

II. — The author then treats of the hydrogen ion concentration within the plant and in the actual living cells, and gives a brief account of the previous work on the subject from which he draws the following conclusions:

Plant cells are rarely alkaline and pH 8 is not exceeded in them. On the acid side pH 1.4 has been observed. By a microchemical method it is possible to determine the pH values of the cells and tissues; it has been found that the xylem is more acid than the pith and medullary rays, and the midrib of a leaf is more acid than the parenchyma. Parenchymatous tissue is often in the neighbourhood of pH 6, while woody tissue is nearer pH 5, or more acid. When grown in alkaline or neutral soil, the root is usually less acid than the other parts of the plant. The author reserves the influence of soil reaction for consideration in another paper.

It has been pointed out that the pH value met with in a tissue is usually near but slightly less than the optimum for the activity of the characteristic enzyme at ordinary air temperature. This ensures that the acidity does not destroy the enzyme at such higher temperatures as may be experienced by the plant under natural conditions.

III. — It has long been known from the results obtained by VOELCKER and other workers (which were collated by HALL in 1910), that finger-and-toe disease occurs in soils poor in calcium salts. The author mentions the case of two adjacent turnip fields of similar clay soil one of which was

badly infested with finger-and-toe disease in the crop, while the other was entirely immune. It was found that the calcium content (calculated as oxide), was respectively 0.17 % and 0.40 %; the hydrogen-ion concentration of the samples was respectively pH. 6.6 and pH 6.7. In other words, the soil of the infected field was the more acid and it would be useful to determine the pH limits within which the fungus producing finger-and-toe disease (*Plasmodiophora brassicae*), is able to develop. G. A. B.

- 234 - Researches Made in Denmark, upon the Effect of Soil Conditions on Bacterial Life and the Chemical Transportations taking place in the Soil: the Capacity for Decomposing Mannite. — CHRISTENSEN H. R. (145 Beretning fra Statens Forsøgsvirksomhed i Plantekultur), in *Tidsskrift for Planteværn*, Vol. XXVIII, Part I, pp. 1-38, figs. 5. Copenhagen, 1922.

The author has previously had occasion to study the power of fixing atmospheric nitrogen, possessed by different soils. The soils were mixed for this purpose with mannite and put for some weeks into a thermostat to incubate (1). The observations made seemed to show that there are considerable differences in the mannite decomposing-power of various soils, and as it also appeared probable that these differences were connected with the agricultural properties of the soils, it was thought well to investigate the whole question of how far a capacity for decomposing mannite depended upon the nature of the soil. A satisfactory method of research was first selected, whence it was found that the moisture content of a soil determines the rapidity as well as the course of the mannite decomposition process, and that in order to attain the approximate maximum decomposition, the humidity must be about 75 % of the water capacity of the soil. Since a large number of ordinary soils had been used the author tried to discover the capacity of mannite decomposition as shown by the rapidity of this process, and following his predecessors, he investigated both inoculated and uninoculated cultures in order to determine the differences due both to the chemical composition and microbiological nature of the soil. He also determined the reaction of the soil samples, and the phosphoric acid soluble in hydrochloric acid and carbonated water respectively, and finally the amount of lime and magnesia soluble in 10 % ammonium chloride.

The author first found that the rate of the mannite decomposition varied within very wide limits; in certain cases, the process was completed in 5 days, in others it was not complete even at the end of 30 days. After due consideration it would appear that there is a definite relation between the reaction of the soil (especially within limits very close to the point where it becomes neutral) and its power of decomposing mannite, for soils that are shown to be well-supplied with lime, and are thus favourable to the development of *Azotobacter*, generally have a greater capacity for decomposing mannite than those having a deficiency of lime and lacking *Azotobacter*. This difference is still more noticeable, if distinctly acid or alkaline soils are compared. There are however notable exceptions to this rule; these seem on the one hand to show that soils with sufficient

(1) See R. 1917, No. 996. (Ed.)

lime possess, more often than those deficient in it, the qualities determining the rapidity of the mannite decomposition process, while on the other hand, no connection has been found between the amount of phosphoric acid soluble in hydrochloric acid present in a soil, and its capacity for decomposing mannite. On the other hand, soils needing no lime, and with much phosphoric acid soluble in water containing carbon dioxide, have also a great power of decomposing mannite; in fact if the concentration amounts to 1.2 mg. of phosphoric acid per litre, mannite decomposes very rapidly in such inoculated soils, with but rare exceptions. Further, the decomposition of mannite takes place as a rule much more quickly in inoculated, than in uninoculated soils; usually however the differences are slight, so that we are justified in saying that the degree in which mannite is decomposed depends chiefly upon the chemical composition of the soil.

In order the better to understand the effects of the chemical factors, the author treated the soils with lime and various phosphate salts. The results proved that the rapidity of the mannite decomposition depended upon the presence of slightly basic lime compounds and readily soluble phosphoric acid.

These facts are of great importance, but further research is necessary with regard to the extent to which the speed of the mannite decomposition in soils needing no lime, may be an index of the amount of phosphate compounds present that are very soluble and capable of speedy assimilation by plants; such an index being afforded by the *Azotobacter* test in the case of soils that are deficient in lime.

A first step taken in this direction by the study of a series of soils proved, by a series of field experiments lasting for several years, to be lacking in phosphoric acid. The results were very satisfactory, for they showed that these soils, which agricultural experience had proved to be decidedly in want of phosphoric acid, had a very low capacity for decomposing mannite, whereas soils well provided with phosphoric acid broke up mannite quickly. Further, when normal amounts of superphosphates are applied for a certain number of years to soils requiring phosphoric acid, the mannite decomposing capacity of these soils is greatly increased. The experiments so far made are, however, not sufficiently extensive to warrant any conclusions as to the practical value of this method in determining the phosphoric acid requirements of the soil.

In the latter part of the article, the author deals with the connection between the reaction and basic character of the soil, and its content in phosphoric acid soluble in hydrochloric acid and in water containing carbon dioxide, and of lime and magnesia soluble in ammonium chloride. These correlations show very clearly that an alkaline reaction and the presence in the soil of certain basic compounds, like those of lime, are necessary conditions of a somewhat high content of phosphoric acid soluble in water containing carbon dioxide, and finally, that the form under which phosphoric acid is found in soils is determined to a large extent by their reaction.

G. A. B.

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235 - The Spring Awakening of Arable Land and the Choice of Agricultural Machines. — RINGELMANN, M., in *Journal d'Agriculture pratique*, Vol. 35, No. 7, pp. 132-133 Paris, February 19, 1921

The author considers LUMIÈRE's paper (1) on the "Spring Awakening of Arable Land" from the point of view of the agricultural machines and operations required. All that is needed is some simple apparatus mounted on a stubble-plough, a pulveriser, or a cultivator with flexible teeth.

According to LUMIÈRE, the roots of plants and also the dead leaves and aerial portions of annual plants secrete toxic products that are inhibitory agents preventing the seeds germinating, and should therefore be removed as quickly as possible by fermentation, oxidation or dilution.

This hypothesis explains the beneficial effects of various cultural operations: dry-farming, ploughing fallow land for a year, the repeated use of a cultivation with flexible teeth instead of ploughing (JEAN method) (2), etc.

It also shows that it is necessary in preparing the autumn seed-bed, only to loosen the soil to a slight depth without turning it but at the same time to dig and subsoil it as deeply as possible, in order to facilitate the free passage of the rain, which first washes the superficial layers of the soil, promoting the germination of the seeds they contain and then, passing on to the greater depths, removes the toxic products from the lower strata at the time the roots of the new plants will reach them. The toxic products would thus be present in relatively large amounts in the lower layers of soil.

The furrows then act as small elementary drains that hasten the removal of soluble substances by the rain water. For this reason it is advisable to use implements with coulters that are relatively narrow for most of their length, but wider at the point, so as to make narrow channels; the section of the latter should be smallest when the soil is most compact and heavy, as this minimises the compression and slipping of the earth.

Ploughing should therefore not be carried to a depth exceeding 10 to 15 cm. After the harvest has been carried, it may be assumed that the toxic products are most abundant in stratum *l* (fig. 1); after ploughing, this stratum, which is for the time unsuited to germination, is arranged in parallel inclined planes *l'*; these after the passage of the roller or harrow take up the position *l''*, so that the seeds finding themselves from the beginning under good germinating conditions are those occupying the triangles *g*; those situated elsewhere will germinate later when the rain has washed the superficial layers. Instead of ploughing to the depth *yo*, it would therefore be better not to go deeper than *ym*, the exact figure is to be found by experiment. It is however, also advisable to loosen the soil *in situ* to the depth *nm*, in order to allow the rainwater to drain away easily and free the strata *nm* from toxic products, before the roots of the crop have penetrated so far.

The best agricultural machines to use are stubble ploughs working to a depth of 7-10 cm., or pulverisers penetrating to 5-8 cm., provided each

(1) See R. Jan. 1921. No. 11. (Ed.)

(2) See R. April 1916, No. 386. (Ed.)

mould-board *A* (fig. 2) is fitted with digging claws or teeth *t* which penetrate as deeply as possible, 20-25 cm. for instance, before the furrow is cut by the plough.

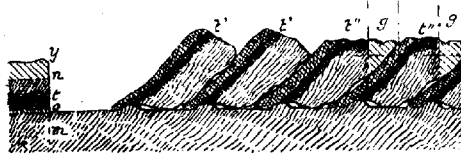


Fig. 1. — Transverse section of ploughing.

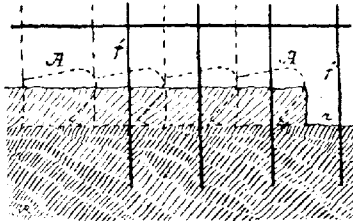


Fig. 2. — Principle of stubble-plough with digging teeth.

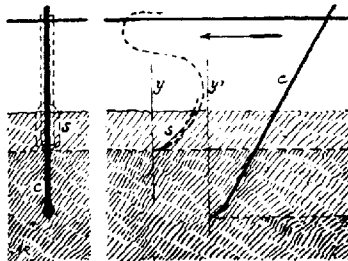


Fig. 3. — Principle of cultivator digging coulters.

Such digging teeth, which resemble coulters, may be introduced between the disks of the pulveriser.

The same principle can also be applied to cultivators. In this case, it would be necessary to affix the digging coulters shown diagrammatically

at *c* (fig. 3), behind each share (*s*) of the cultivator (or every second share), the latter working a breadth of 12.5 cm. (teeth per metre of width of the carriage), and to a slight depth. The distance between the verticals *y* and *y'* by passing the extremities of *s* and *c*, which will give most work with the minimum traction, must be determined by experiment.

After the passage of the above-mentioned machines it is well to use a clod-breaking roller to consolidate the surface. The roller, which must be of the required breadth, can be attached to the back of the machine. The loosened superficial layers must settle down, for in LUMIÈRE'S experiments its consolidation is proved by the water used for washing the soil.

The seed being sown at depths varying from 3 to 6 or 7 mm., it is only necessary to loosen the soil to a depth of 10 cm. in order that the first rains can rapidly wash the surface.

What has been said refers solely to the preparation for the autumn sowing, for in the spring the rains and snows of winter insure the soil being washed to a depth below where the seeds are lying. Further, the ground is well ploughed in the autumn, and superficially ploughed several times in spring, which agrees well with LUMIÈRE'S experiments.

G. B.

235 - The Conversion of Straw into Farmyard Manure. — HUTCHINSON, H. B. and RICHARDS, E. H., in *The Journal of the Ministry of Agriculture*, Vol. XXVIII, No. 3, pp. 398-411, figs. 2. London, August 1921.

As a result of the recent extension of the area under cereal crops, it was thought that there might remain a surplus of straw which could not be employed for the usual purposes of stockfeeding and litter. It was therefore determined to investigate the possibility of converting it directly into manure, in order to supply the market-gardeners who found it increasingly difficult to obtain adequate supplies of stable-manure.

As a result of experiments carried out at the Rothamsted Experimental Station, a method was devised by which straw can be converted into a substance having many of the properties of stable manure.

In a considerable number of the preliminary experiments, to secure the usual disintegration and colour changes in fermenting straw, the most promising results were obtained when the straw was subjected to the action of a culture of aerobic, cellulose-decomposing organisms (e. g. *Spirochaeta cytophaga*). Further enquiry showed, however, that this effect was not due simply to the presence of an organism capable of breaking down cellulose, but rather to the indirect effect of the mineral substances contained in the culture fluid. From this stage onwards, the question of food supply, as distinct from the addition of any particular species of organism, received special attention and the results obtained were of both theoretical and practical importance.

The great importance of air supply, was shown by an experiment in which 4 lots of straw were fermented under aerobic and anaerobic conditions for 3 months at 37° C. The results were as follows:

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	Loss of dry matter	
	Straw without Nitrogen	Straw with Nitrogen
Without air supply	16.3 %	17.1 %
With air supply	40.1	58.9

As a rule special measures to maintain a favourable temperature are not necessary. Moist straw rapidly undergoes a preliminary fermentation during which the temperature may rise to over 65° C. It is, however, in the subsequent stages that the effect of treatment has most effect in maintaining the temperature. Experience has shown that a supply of nitrogen, by increasing the energy of fermentation, leads to an increase of 15-20° C in favour of straw which has received a sufficient supply of nitrogen, as compared with untreated straw.

Repeated experiments have proved that the most rapid break-down of straw occurs when some source of nitrogen in an available or indirectly available form was supplied, but only when the reaction of the solution was neutral or slightly alkaline. The addition of urine, urea, ammonium carbonate or peptone, with certain concentrations, immediately sets in train rapid decomposition changes. The highest concentration for quick break-down is appreciably below that of the weakest undiluted urine; hence it is quite impossible to obtain well-rotted dung by the use of neat urine without considerable loss.

Equally good rotting may be obtained without loss of nitrogen, as was shown by experiments in which straw was incubated with urine in different concentrations for periods up to 86 days; even after this period, the losses that occurred with satisfactory rotting and within the lower concentrations, were only about 4 % of the final nitrogen. The ordinary losses of the manure heap are frequently more than tenfold this amount.

In addition to the two phases already mentioned, *a*) in which the straw supersaturated with nitrogen loses it to a definite degree, and *b*) in which straw with the requisite amount of nitrogen may undergo rotting without appreciable loss and is therefore in a state of equilibrium, there is a third phase, in which undersaturated straw exhibits a well-marked property of fixing nitrogen by the agency of micro-organisms, especially in the form of ammonia, until the same final content of nitrogen in the rotted product is attained.

As a rule, the nitrogen retained by supersaturated straw (that is to say straw containing more nitrogen than will remain in the final product), and such as is accumulated by undersaturated straw (*viz.* straw containing less nitrogen than the amount present in the final product), appears to be stored up in an organic, or non-ammoniacal form. The maximum retention of nitrogen has been found to occur within the first 4 weeks, after which the breakdown of this organic nitrogen to ammonia and the

consequent loss by volatilisation seems to keep pace with the loss of dry matter. Finally the material assumes a "stabilised" condition, the loss of nitrogen becoming greatly diminished or even absent altogether for long periods.

Between the 60th and the 120th day little change is found to take place, either in the amount of stable or fixed nitrogen, or in the proportion of this nitrogen and the ammonia which appears to be held by fermented material even at a high temperature (37°C), in spite of constant handling. In general it may be stated that when straw has worked from an unsaturated to a stable phase, little or no free ammonia is to be found, but straw which starts with a superabundance of nitrogen, appears to hold, when in a fermented state, upwards of 14 % of its nitrogen in the form of ammonia so long as the material is in a moist condition. Desiccation leads to almost complete loss of ammonia and in this respect, as well as in the proportion of ammonia in the moist material, the artificial manure resembles natural manure.

From the study of the inter-relations between nitrogen and straw the authors have come to the conclusion that the amount of nitrogen necessary for pronounced rotting, and the amount the straw is capable of "fixing" in the form of ammonia are identical, and that in general, the figure varies only between 0.70 and 0.75 parts of nitrogen per 100 parts of dry straw. Within these limits fermentation proceeds without loss of nitrogen, and it is obvious that except in so far as the nitrogen content of the original straw varies, the final "stabilised" product obtained when rotting has proceeded to an appreciable extent must likewise exhibit comparatively slight variation in its nitrogen content. If for example the nitrogen content of the original straw was 0.5 %, and we assume that the theoretical amount of ammonia nitrogen equal to 0.72 lb. of nitrogen per 100 lb. of straw, has been fixed, then with a loss of 40 % of dry matter during fermentation, the resulting rotted straw will contain

$$\frac{(0.50 + 0.70) \times 100}{60} = 2.03 \% \text{ of organic nitrogen in the dry matter.}$$

The data thus obtained lead to a consideration of the process of inducing the fermentation of straw on a large scale, and can also be applied to the conditions operating in the production of ordinary farmyard manure.

As regards the preparation of artificial manure (1), experience has shown that urea and ammonium carbonate are the most suitable carrier of nitrogen, since they insure favourable alkaline reaction, and the rapid decomposition of the straw, but as they are very expensive, it is best in large scale experiments, to use cyanamide or sulphate of ammonia. While cyanamide already contains sufficient free lime to keep in check any acid compounds formed during fermentation, sulphate of ammonia must be supplemented by the addition of a base, and for this purpose finely ground chalk, ground limestone or waste lime from causticising plant at soap

(1) This process, as well as its application to the purification of sewage has been covered by Letters, Patent, (Brit. Patent No. 152387). (Author's Note)

works may be used. For general purposes, it will be found that upwards of $\frac{3}{4}$ cwt. of sulphate of ammonia and 1 cwt. of finely ground carbonate of lime per ton of straw are sufficient to induce fermentation. The main obstacle to large scale operations arises from the great tardiness with which raw straw takes up the moisture necessary for fermentation. Where pits are available, this difficulty may be overcome by allowing the straw to remain immersed for 2 to 4 days, after which the free liquid may be drained off. In the case of heaps or stacks on open ground, no advantage appears to be gained by continued wetting with large quantities of water and the authors suggest sprinkling the heaps comparatively lightly with water and allowing a couple of days to elapse before repeating the operation. The slight fermentation that sets in after the first sprinkling renders the straw more capable of absorbing the water of the second. When examination has shown that the interior of the heap has become uniformly moist, the source of nitrogen may be applied in the form of solution; or in the case of cyanamide and other products, this may be broadcasted over the surface of the heap and watered in.

Artificial manure is identical in physical properties with well-rotted manure, and differs from it in chemical composition only in so far as it does not contain (in addition to nitrogen), the appreciable quantities of phosphorus and potash derived from the foods consumed by the animals. Of the three constituents ordinarily present in manure — urine, faeces and straw — the faeces appear to contribute only to the physical character of the product; and as the nitrogen they contain is inert, require to be furnished with the nitrogen needed for the decomposition of the straw instead of fixing it themselves. The average of 26 analyses of the faeces of the horse, cow and sheep showed the percentage of nitrogen to be almost the same as in fermented straw, viz. 1.93. The mean content of fixed, that is to say not ammoniacal, nitrogen in manure made under controlled conditions in America and Europe proves to be 2.09 % as a mean of 43 records. During the rotting of dung, a large amount (over 40 or 50 %) of the nitrogen contained in the food and litter is almost invariably lost, and this loss appears to fall largely or even exclusively on the urine nitrogen which is the most valuable constituent of the manure since it is the most readily available. Both chemical and physical measures have been suggested to prevent or reduce this loss, but they have either proved ineffective, or have interfered seriously with the rotting process.

If dung making be regarded as essentially a straw-rotting process, this loss is capable of explanation. It has been seen that the nitrogen-fixing power of straw is strictly limited and that any surplus nitrogen in the form of ammonia is liable to loss by evaporation. It may therefore be assumed that the practice of supplying concentrated feeding stuffs to farm livestock merely results in an increased production of soluble nitrogen, which owing to the normally overloaded conditions of the litter, is liable to relatively greater loss than where such feeding stuffs are not used.

A fairly close approximation to the actual results of a number of feed-

ing experiments may be obtained by taking the sum of: 1) the amount of nitrogen present in the litter (which is not subject to loss); 2) the amount of faecal nitrogen calculated by means of the digestion coefficients of the food consumed; 3) the nitrogen that the litter is theoretically capable of fixing (0.72 lb. per 100 lb. of straw); 4) the ammoniacal nitrogen present in the manure.

For this reason the authors advise a more liberal use of litter as a means of reducing the losses that occur in the making of manure.

F. D.

237 - **Supplies of Organic Matter in the Soil; Research carried out at the Rothamsted Experimental Station (England).** — RUSSELL, E. J. (Director, Rothamsted Experimental Station), in *The Journal of the Ministry of Agriculture*, Vol. XXVIII, No. 9, pp. 779-782, figs. 2, London, December 1921.

Recent experiments emphasise the importance of having ample supplies of organic matter in the soil, although some of the older agricultural chemists were inclined to the view that artificial fertilisers were the chief source of soil fertility and all that need be done was to apply them in the required amounts. Organic matter however as supplied by farmyard manure improves the conditions for the root-crops, facilitating the production of tilth and increasing the water-holding capacity of the soil. It also improves the growth of clover, and causes less variation in yield from year to year than artificial manure; further, its use involves less risk of deterioration of soil when the course of cropping is abnormal, as in cases where the field receives an insufficient amount of fertiliser, or a manurial treatment deficient in one or more essential constituents.

*Comparison of Farmyard with Artificial Manures.
Continuous Wheat.*

Plot No	Treatment	Average yield bush. per acre	Mean annual diminution bush. per acre	Percentage of relative variance ascribable to weather
2 b	Farmyard manure, 14 tons annually	34.549	0.031	2.78
3 and 4	No manure	12.629	0.097	6.20
5	Complete mineral manure	14.180	0.090	5.84
6	As 5 + single ammoniacal salts	22.581	0.141	6.01
7	As 5 + double ammoniacal salts	31.367	0.144	5.11
8	As 5 + treble ammoniacal salts	35.694	0.092	4.18
10	Double ammoniacal salts alone	19.504	0.157	17.10
11	As 10 + Superphosphate	22.046	0.219	10.32
12	As 10 + Super + Sulph. Soda	28.319	0.181	7.28
13	As 10 + Super + Sulph. Potash	30.209	0.123	5.55
14	As 10 + Super + Sulph. Magnesia	27.765	0.231	6.38
Alternate	17 Mineral alone, or double ammoniacal salts alone, in alternate years	14.510	0.092	10.16
	18	29.006	0.114	4.55

The following data, which represent the results of a series of experiments lasting 68 years, prove without any doubt that farmyard manure is more dependable than other fertilisers, although it is not capable of giving so good yields in favourable seasons as a properly balanced mixture of artificials.

The superiority of farmyard manure to artificials is shown by two diagrams. One proves the steadiness of its effects as compared with the effects of a complete manure, phosphatic manure, and a nitrogen-potassic and phosphato-potassic manure respectively, in increasing the yield of continuous crops of barley grown from 1852-1919. The other shows the effect of farmyard manure and of artificials on clover and wheat (grain and straw) succeeding a corn crop.

A good deal of work is being done at Rothamsted and elsewhere to discover the scientific reasons for these various effects and the best way of using farmyard manure, but in the meantime there is another and far more urgent problem; how can the supply of farmyard manure or similar materials be increased?

Two general methods are being studied at Rothamsted. The first consists in reducing the wastage in making and storing farmyard manure, which is very considerable. The second consists in actually increasing the supply of farmyard manure or like substances on the farm, either by keeping more livestock, or by adopting substitutes for farmyard manure. The success attained in the experiments in progress at Rothamsted on the decomposition of straw by artificial means makes it most probable that given a proper air and moisture supply, suitable temperature, freedom from acidity and the addition of the right proportions of soluble nitrogen compounds, a substance resembling farmyard manure can be produced.

Another method of attaining the same object is by the use of green manuring, but for this to be an economic possibility it is necessary to sow a catchcrop after the harvest. Sewage can also be used and an extensive experiment, which was carried out at Rothamsted from 1918-1920, has proved that "activated sludge" gives a fertiliser of high value (1), very considerably better than anything yet obtained.

G. A. B.

38 - **Physic Nut Cake as a Fertiliser.** — See No. 267 of this Review.

39 - **The Recent Conference at Rotterdam and the Future Prospects of Nitrate of Sodium.** — *Caliche*, Year III, No. 9, pp. 420-431. Santiago (Chili), December 1921.

The difficulty in estimating the consumption of nitrogenous fertilisers during the current season, and the great uncertainty prevailing as to their price, owing to the size of the stocks have naturally had the effect of arresting the anticipated demand. An important conference on the subject was held at Rotterdam on June 20, 1921, which was attended by the representatives of the Association of the Producers of Nitrate of Sodium, of the British Confederation of Ammonium Sulphate and of the German Ni-

(1) See R. Sept. 1920, No. 843. (Ed.)

trogen Syndicate respectively. The object of the Conference was to fix the prices of the different nitrogenous products.

It was unanimously agreed that nitrogen consumption could be greatly increased by a better propaganda and by fixing the price. It was stated, as an illustration of this fact, that the consumption of nitrogenous products had been increased 75 % in Germany in 1920, owing to the uniformity of prices, although the cost had risen to double the expected amount. During the same period, the propaganda expenses incurred by the German Nitrogen Syndicate, in Germany alone were more than twice as great as those paid by the Association for the Production of Nitrate of Sodium throughout the world. The possibility of a more energetic nitrate propaganda undertaken in collaboration with the other producers of nitrogenous fertilisers was thus clearly demonstrated and it ought to be equally feasible to associate this important branch of the industry with the production of the two other chief types of fertiliser, phosphates and potash, in order to obtain the full benefit of co-operation. Another point raised at the Conference was the question of establishing an International Credit system similar to that already instituted in Germany which allows of credit being advanced to agriculturists on the value of their crops up to 50 % of the cost of the nitrogenous fertilisers purchased which would greatly increase the consumption of fertilisers to the great advantage of impoverished land. The stock of complete fertilisers in Germany which previous to the War amounted to 450 000 tons of nitrogen as against a consumption of 200 000 tons of nitrogen in the form of nitrate of sodium and sulphate of ammonia has now fallen to $\frac{1}{3}$ of this figure, but it is believed that by means of active propaganda the farmers can be induced to cover this deficit by the use of sulphate and nitrate of ammonia which would mean an increase of 1 500 000 tons in the consumption of these fertilisers in Germany alone. Long discussions were also held with a view to settling the basis of an agreement between the different manufacturers of nitrogenous products and the suggestion of fixing the price on the markets of consumption at 15 pounds sterling per ton met with unanimous approval, this price being considered quite fair to customers under the present conditions.

The present abnormal situation has had the result in Chili of closing many factories for the extraction of nitrate of sodium; the monthly production has therefore fallen below 100 000 tons, as against an average of 210 000 tons in the preceding year. The Chilian Government regards the situation as one of extreme gravity, for in the nitrate working centres there are already 40 000 men unemployed and if some speedy agreement is not made with the holders up of the stock, unemployment will still further increase. The Chilian Government is evidently following with the greatest interest the negotiations now in progress and has allowed it to be understood that if some agreement is not soon reached, it will be obliged to resume its liberty of action.

Owing to the fall in the exchange and the lower price of sacks and fuel the cost of production has greatly diminished, being estimated at 6 to 8 shillings per Spanish quintal (46.02 kg.) except in certain isolated cases.

The previous sales at high prices have given the producing societies solid position which enables them to face the present situation and even they effect no further sales before 1922, the profits obtained up to December 1921 should leave them well content. The future of the industry however, uncertain, but if an agreement can be arrived at between the principal nitrogen producing companies to fix the price at 15 pounds sterling, there would be a sufficient margin of profit to cover present expenses, and more energetic propaganda would also do much to increase the receipts.

To sum up: the nitrate of sodium industry is now passing through one of the periods of crisis to which its market has always been subject, and the present situation may be regarded as temporary and due to the general economic situation, not to a change in the views of the world's consumers of nitrogen.

G. A. B.

3 - Studies relating to the Anatomy and Physiology of the Sugar-Cane in Cuba. — MAMELI CALVINO, E. (Jefe del Departamento de Botánica de la Estación Experimental Agronómica, Habana), in *Estación Experimental Agronómica, Boletín* No. 46, and *Revista de agricultura, comercio y trabajo*, Year IV, No. 4, pp. 551-555. Havana, 1921.

AGRICULTURAL
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PHYSIOLOGY
OF PLANTS

The author gives an account of the attempts made to secure new varieties of sugar-cane by means of sexual reproduction. He criticises the methods adopted to obtain seedlings (alternate rows; castration of the flowers; self-pollination, cross-pollination with the aid of bags; cross-pollination without protecting the flowers with bags). He describes the varieties "Cristalina", "Uba" and "C 291" and their distinguishing morphological characters (epidermis of the internodes, nodes and leaves; lenticular bodies; waxy covering; starch grains, hairs of the auricles and surrounding the leaf-blade. He passes on to speak of the conditions determining the flowering of the sugar-cane and gives a critical review of the results hitherto obtained by experiment from which he draws the following conclusions:

1) The methods hitherto adopted for protecting inflorescences in order to guarantee paternity in crosses between varieties of sugar-cane are insufficient to prevent the possible intrusion of foreign pollen, as such pollen is able to find its way through muslin, and even finer materials. The use of bags of paraffined paper or glass boxes entails the drawbacks of ineffective air circulation and rise of temperature.

It is necessary in each country to study the protective devices best suited to the local conditions of humidity and temperature. The author suggests the following method as adapted to all Experiment stations where sugar-cane is sown. A greenhouse, either fixed or movable, should be constructed above or below ground in which the crossings can be made by enclosing the inflorescences of the female plants with pollen. The plants to be crossed can be grown directly in the greenhouse, or else in the open in pots or boxes, and transplanted into the greenhouse with all necessary precautions, when just about to flower. If movable greenhouses are used, they can be erected over groups of sugar-canes flowering in the field; care must be taken to prevent the entrance of strange pollen, which, however, in this case is comparatively easy.

The fixed greenhouse offers greater security; it can be divided into compartments by fixed or movable partitions, so that many crosses with different varieties can be made at the same time.

By this method all the errors inseparable from the use of bags of material are avoided and it would be possible to undertake accurate researches on the subjects of self-sterility and self-fertilisation under the best conditions for the fertilisation of the sugar-cane.

2) The macroscopic and microscopic characters of the inflorescence though hitherto generally neglected in the descriptions of the different varieties, are of the greatest importance in their identification and also in the choice of the best individuals for crossing.

3) The histological study of the sugar-cane has revealed considerable differences between very nearly related varieties.

4) The conditions causing the irregular flowering of the sugar-cane are at present unknown. It would be necessary to take into account in each district the data relating to the temperature, the hygroscopic state of the atmosphere and soil, the duration of insulations and the light intensity during both the vegetative and flowering periods.

5) In Cuba the sugar-cane usually flowers from December to March, though some varieties may flower to the end of April. At the Havana Experiment Station, there are 18 varieties that have never borne flower. On the other hand the varieties *Cristalina*, and *Uba* from Natal, and a number of seedlings obtained at the Station itself, flower every year. Of these C46 and D99 bore flowers at the age of 7 months.

6) The pollen of the sugar-cane contains a considerable amount of starch from the beginning of the formation of the pollen-grains in the pollen mother-cells, and it only disappears when the pollen-grain is about to pass down into the pollen tube.

7) Pollen grains with no starch are as a rule abortive and morphologically abnormal.

8) Among the varieties grown at the Havana Experiment Station, some have normal pollen in all their inflorescences from December to March; whereas in others the pollen is abortive in the inflorescences of February and March. On the other hand the *Uba* sugar-cane from Natal produced in 1920, inflorescences with abortive pollen from December to March, and one inflorescence with much normal pollen at the end of April.

9) Some of the inflorescences of the same variety coming from different localities may contain normal pollen, while the pollen of the others may be abnormal.

10) Sugar-cane pollen will not germinate in the ordinary cultural media; several different substances were tried, amongst them were the viscous stigmata of the flowers of *Nicotiana Tabacum* var. *havanensis* which proved quite satisfactory.

11) As a result of the microscopic examination of the pollen and pistils of 36 varieties of sugar cane, 20 crosses were made at the Havana Experiment Station, and out of the 100 seedlings produced, 15 bore fertile seed.

12) The seeds of 14 varieties believed to have been fertilised by natural pollinisation were also planted; 8 of the resulting seedlings bore fertile seed which produced 29 plants.

13) From the author's studies it would appear that the presence of starch in the styles, is not a character associated in any way with the fertility of the ovaries, for varieties like C7, C30, C37 and H109, which were found to have no starch in their styles, produced fertile seed both in the case of the naturally and of the artificially pollinated plants.

14) The present experiments of the author in Cuba, shew that the minimum time for the germination of sugar-cane seeds is 3 days, the maximum being 8 to 10 days. As a rule the seeds take 5 to 6 days to germinate in the sterilised boxes for propagation.

F. D.

241 - Notes on the Work of the Phytotechnical Station at Gayerovo (Paraná), Brazil. — ZEDNECK and GAYER, C., in *Boletim de Agricultura, Commercio e Industria*, Nos. 1-3, pp. 3-10. Bahia (Brazil), March 1921.

In the selection of cereals, the following characters are taken into account: number of culms; length of culm; length of ear; number of grains per plant; weight of 1000 grains; weight in gm. of the culm, ear, grains, awns, of the second internode of the culm; total weight of grains of a single plant; density of ear; resistance coefficient of the culm and of the 2nd internode; shape of leaves; plant mass.

WHEAT. — 400 plants of the Barleta variety were chosen in the first place; of these 11 were employed as heads of lines (mother plants), and the others for mass selection.

As a first result of the latter process may be mentioned Barleta, Paraná, type 1914, which gives a higher yield than the original strain.

In addition to selection work the Station has undertaken comparative cultural experiments with 3 Japanese varieties: Sgatimgo, Eshima, Shiro and Shirobaya of which the first is distinguished by its early maturing: it ripens in 3 months only, this is a valuable character under the climatic conditions existing at Gayerovo.

The Station has also made pedigree selections of *rye* and comparative tests of some varieties of *oats*, in order to study their rust resistance. Excelsior (from Rio Grande do Sul), is practically immune, whereas the North American types Aurora No. 831, Fulghum No. 408, and Red Rustproof No. 518-3 were severely attacked by the fungus.

MAIZE. — Characters forming the object of examination: vigour of culm; shape of leaves; early maturity; weight of ear in gm.; length of ear; circumference of the lower, middle, and upper thirds of the ear; number of rows of grains; number of grains per row; total number of grains per ear; weight of rachis in grammes and in % of whole ear; weight of grains of a single ear; weight of 1000 grains.

Selection work has been begun on Golden Dent, the variety that seems most suited to local conditions, with a view to further improving it and preserving its purity.

The female parents had been the Campea ear, a prize-winner at the Rio de Janeiro Show, and 4 other ears chosen on the field.

The seed from the Campea ear produced plants that were already clearly superior to all the others. Comparative cultural experiments were also made with *Dr. Assis*, *Brazil*, *Horsting Prolific*, *Gerrick*, *Loveliest* and *Laguna*.

PULSE CROPS. — Characters investigated: number of pods per plant; number of seeds per pod; total number of seeds; weight of seeds per plant; weight of 100 seeds; disease resistance, etc.

PEAS. — From the comparative cultural tests it was found that the most suitable varieties are *Buri's Early*, *Morning Star*, *Prosperity* and *Bliss Everbearing*.

POTATOES. — Characters investigated: total number of tubers; total weight of tubers; average weight of a single tuber; mass of foliage and haulms; disease resistance.

In the variety *Silezia* are found united in the best proportion the 3 characters: high yield, good quality and disease resistance.

The selection of this variety was begun on 3 lines, Nos. I, II, III.

The French beans, the cotton plant ("Express" variety), and the pea-nut were also made the subjects of experimental researches. The following 4 varieties of the pea-nut were examined: *Indios Nhambiquara* (grown by the Indians of this name), *Parecis* and *Tupis de Matto Grosso*, *Hespanhol Rasteiro*, *Red Pea-nut* and *Gayerovo*. The Indian variety is distinguished by the size of the seeds which are 4 times as large as ordinary pea-nuts.

G. A.

242 — **Hereditary Behaviour of a Dwarf Form of Barley in Japan.** — MIYAZAWA BUNGO, in *Journal of Genetics*, Vol. II, No. 3, pp. 205-208, 20 plates. Cambridge, December 1921.

From crossing one individual, " F_1 Goldenmelon \times Sekitori", with the Goldenmelon parent, 96 offspring were obtained, one of which, a dwarf plant, was interesting as regards its hereditary behaviour.

The characters of this plant together with those of its parents, are as follows:

	Goldenmelon	Sekitori	Dwarf Plant
Height of plant	tall	short	less than Sekitori
Rows in ear	2	6	2
Length of awns	long	short	long
Time of ripening	late	early	later than Goldenmelon

Although this dwarf plant tillered more abundantly than normal varieties, over half the shoots thus developed failed to produce ears.

In November 1915 about 40 seeds of this dwarf plant were sown, and in 1916, 24 plants were obtained, 18 being dwarfs and 6 normal (ratio: 3:1). In November seeds taken from 9 dwarf and 6 normal plants were sown; in 1917 all the normal plants were found to breed true to type.

whereas the offspring from the dwarf plants contained 292 dwarfs and 161 normals (64.5 and 35.5 % respectively).

It is thus seen that:

- 1) The dwarf character is dominant.
- 2) All the dwarfs are heterozygous, for as the ratio of dwarfs to normals is approximately equal to 2 : 1 instead of 3 : 1, it is clear we are not dealing with a typical segregation.

DE VILMORIN has already studied the dwarf forms in wheat and always obtained 2 dwarfs as against 1 normal, so that this result might be caused by the fact that any zygote homozygous in respect of dwarfness is either not produced or dies very early.

The present case is very similar to that described by VILMORIN and in the author's opinion, might be explained by one of 2 alternatives.

- 1) Seeds containing zygotes homozygous with dwarfing do not germinate (this hypothesis is excluded by the results of the germination tests);
- 2) Such seeds die soon after germination.

In order to test the second hypothesis the author sowed some seeds from dwarf and normal plants in pots and placed the latter in a cold frame to protect them from severe cold. In late April he discovered among these seedlings quite a new dwarf-form (a sterile dwarf), which tillered freely (in some cases 152 shoots to a stock), but grew very slowly and produced no ears; the length of the culms was much less than in the dwarf type mentioned above. By the middle of June all these plants died as a result of the attack of *Erysiphe graminis*, whereas the other two types (the normal and fertile dwarf), had completed their growth.

Out of 323 plants there were: 71 sterile-dwarf, 172 dwarf, and 80 normal, according to the ratio 1 : 2 : 1 (80.75 : 161.50 : 80.75). In the preceding experiments, a certain number of sterile-dwarf plants must have escaped notice owing to their weak constitution which caused them to succumb to the severe cold. In a control experiment made by sowing some seeds of the dwarf plants in the early spring, so as to enable them to escape the winter, 684 plants were obtained; of these 156 were sterile-dwarf, 340 dwarf, and 188 normal, the ratio of the 3 types being approximately 1 : 2 : 1.

CONCLUSIONS. — The dwarf plant found in 1915 at the beginning of the experiments was heterozygous with respect to the character in question and was intermediate externally; *i. e.* shorter than normal, but taller than sterile-dwarf. In other words, if we denote the allelomorph for dwarfness by **D** and its absence by **d**, we have sterile-dwarf = **DD**, normal = **dd** and ordinary dwarf = **Dd**.

G. A.

¹⁴³ - Svalöfs Odal, a New, Early Variety of White Oats suited to North Sweden. — ASERMANN, A., in *Sveriges Utsäddärenden* 3, *Tidskrift*, Year XXXI, Part 6, pp. 244-256, fig. 1. Malmö, December 1921.

Of late years as regards oats, one of the most important breeding problems in North Sweden, was the method of obtaining a type in which very

early maturity is associated with the valuable qualities found in the Guldregn variety viz., high yield, good quality of grain and strong straw.

A type of this kind was especially needed in districts where, as Guldregn and other varieties had proved too late, agriculturists had fallen back upon inferior white sorts such as Dala and native oats. Moreover where Guldregn is already habitually grown and even in the latitude of the south of Dalarna, cold seasons occasionally spoil the crops which do not ripen properly, so that an earlier variety is desirable also in these parts of Sweden.

For this reason, selection work was carried out on an early oat from North Scandinavia, and the final result was Dala of Svalöf, a white oat ripening certainly a little before Guldregn, but with poor straw and low yield and hence not extensively cultivated.

Subsequently NILSSON-EHLE crossed Dala with Guldregn and by selecting the offspring of this cross, obtained amongst others, o 1163 *b* which was tested and at once put on the market under the name of Svalöfs Odalhavre (Svalöf's Odal). In this hybrid the good characters of Guldregn were associated in the right proportion with early maturity. Odal does not head early, but ripens quickly, so that the interval between the appearance of the panicles and the maturity of the grain is considerably shortened (See Table I).

TABLE I. — *Duration of the growth period (in days) for certain lines of Guldregn Dala at Svalöf and at Holm (Angermannland).*

Sorts	Svalöf 1912-1919		Holm 1917-1920	
	Until heading	Until ripening	Until heading	Until ripening
o 3861 Guldregn	66	108	57	95
o 1261 from o 386 × o 924 . . .	66	104	—	—
o 1163 Odal	65	104	56	94
o 924 Selected Dala	67	102	55	90
White oats from the north .	—	—	35	90

Thus, as regards precocity Odal ranks between its parents, being earlier than Guldregn, but later than Dala.

From the point of view of grain production, it yielded on an average at Svalöf 9 % higher than Dala (average 1912-1919): Odal, 34.12 quintals; Dala 31.04 quintals: the best crops were obtained in the good years 1912-1913-1915-1916, whereas in 1914 and 1917, years of severe drought, the yield was somewhat low.

Thus the new type would appear to have inherited specifically high productivity from Guldregn, but to have lost, at least to some extent, the capacity (peculiar to Dala) of giving a high yield, even under less favourable climatic conditions.

On the other hand, it produces less straw than either Dala or Guldregn: this is due to the shortness of the culms (Odal 41.76 quintals; Dala

45.06 quintals; Guldregn 44.16 quintals). Similar results were obtained at the Sub-Station of Ultuna (Domnarfret territory) as well as in the district of Kopparberg, where Odal proved itself superior to the black oats Björn and Orion, both as regards grain and straw.

At the Sub-Station of Varpnäs (South Värmland), Odal has surpassed Guldregn two years out of three, and very encouraging results have been obtained in the district of Gävleborg where this kind of oats is being more and more cultivated.

Table II gives the data of a series of cultural experiments made at Holm, in the southern part of Ångermanland.

TABLE II. — *Straw and grain yield per hectare of several types of oats at Holm (Ångermanland) in 1917-1920.*

Type of Oat	Average		Yield as compared with that of Guldregn = 100	
	Grain	Straw	Grain	Straw
0386 Guldregn	2948 kg	3920 kg	100.0	100.0
01163 Odal	2950	3778	100.0	96.4
0924 Selected Dala	2820	3928	95.7	100.0
White Oat of the North	2655	3773	90.1	96.4
01163 & of 0386 × 0924	3313	4273	112.4	109.0

It should, however, be mentioned as regards the data of Table II, that Holm is situated in a very favourable position; therefore it would not be wise to apply the conclusions to all the district of Ångermanland and to the northern part in particular where the duration of the growth period is much reduced.

The introduction of Odal into Västerbotten must be limited to the most favoured portions of the province. This variety is too late for Jämtland and should not be introduced.

As regards the strength of the straw (resistance to lodging), Odal proved itself distinctly superior to Dala, and nearly equal to Guldregn in the practical tests made at Svalöf (See Table III).

TABLE III. — *Comparative resistance to lodging of Odal and other types of oats.*

Sorts	Degree of strength of Straw 10 = remains quite erect 1 = laid even with the ground	
	1918	1919
386 Guldregn	7	9
1161 a, from 0386 × 0924	—	7
1163 b, Odal	6	8
1163 d, from 0386 × 0924	—	8
1241 Selected Dala	3.5	5

In its general morphological characters, Odal is very similar to Guldregn; its grain is of fine yellow colour, and is slightly larger than that of Guldregn. Table IV gives the weight per hectolitre of 1000 grains and the % weight of the grains.

TABLE IV. — *Characters of the grain in some lines from the cross Guldregn × Dala According to the Data Collected at Svalöf, Domnarvet and Holm.*

Varieties	Svalöf 1912-1919			Domnarvet 1913-1919			Holm 1917-1919		
	Weight of 1 hectolitre in kg.	Weight of 1000 grains in gr.	Percentage of grain	Weight of 1 hectolitre in kg.	Weight of 1000 grains in gr.	Percentage of grain	Weight of 1 hectolitre in kg.	Weight of 1000 grains in gr.	Percentage of grain
0386 Guldregn . . .	53.0	30.6	75.3%	54.9	32.6	76.2%	40.5	34.0	73.4%
01161 from 0386 × 0924	50.8	29.4	73.0	52.6	30.9	75.1	—	—	—
01163 Odal	50.5	29.7	72.9	51.7	32.8	75.4	40.9	35.1	71.9
0924 selected Dala	50.0	27.2	72.3	51.1	28.7	73.9	41.9	31.4	71.8
White Oats from the North	—	—	—	—	—	—	39.4	27.1	67.8

The grain percentage and weight of 1 hectolitre are slightly less than in the case of Guldregn, but higher than in Dala.

From the results obtained, it may safely be said that the object of the selection processes have been to a large extent attained. The aim was to obtain an earlier type than Guldregn, but possessing its excellent qualities. It is true that in this case as in most crosses it was not possible to unite the positive characters in the degree in which they were present in the parent plants.

The result is, however, eminently satisfactory and the new variety can well be used instead of Dala as a substitute for Guldregn in districts where Guldregn has been found to ripen too late.

G. A.

214 - The Inheritance of the Character "Yellow Striping of Leaves" in the Oat-CHRISTIE, W., in *Zeitschrift für Induktive Abstammungs und Vererbungslehre*, Vol. XXVII, Part. 2, pp. 134-141, 1 fig. Leipzig, December 1921.

The author in 1914 found in a pure line of oats "Moistad Grenadier" (isolated in 1906), a single plant with well-marked longitudinal yellow stripes on its leaves and even on the glumes.

In 1915 he obtained by self-fertilisation, 8 striped and 2 green individuals. None of the latter bore seed capable of germinating; on the other hand, 3 of the former plants produced offspring forming a total of 24 green and 19 striped individuals (1916).

In 1917 out of the 14 green 1916 plants, 5 had green progeny, and the descendants of the others segregated into green and striped specimens whereas out of 7 of the striped plants, 2 had striped descendants and the others had both green and striped offspring.

As regards the segregation proportions, these varied greatly from one plant to another: the totals were:

In the progeny of green plants: 302 green and 112 striped.

In the progeny of striped plants: 33 green and 98 striped.

This work was continued in 1919 and 1920.

The results obtained during the last year may be briefly summarised as follows:

Summary of the results obtained in 1920.

Colour of the leaves of the mother-plants	No. of plants in 1920		Colour of the leaves of the mother-plants	No. of plants in 1920	
	Green	Striped		Green	Striped
<i>Green (constant)</i>			<i>Striped (segregating)</i>		
Total for 66 numbers.	1674	—	No 8	9	11
<i>Green (segregating)</i> . .	6	—	» 104	4	2
Total for 20 numbers . .	68	—	» 71	1	—
No 33	2	2	» 73	—	3
» 148	4	2	» 103	—	2
» 150	6	11			
Total for these 3 numbers	12	15	Total for these 5 numbers	14	18

The green type therefore only exceptionally splits up into green and striped descendants, and in very variable and indefinite proportions. As a rule the striped individuals out-number the green. Some of the green plants resulting from segregation are fixed, while the others are liable to segregation. The *striped* type can give rise to the *green* by segregation and the green type in turn can produce the *striped*. This phenomenon, together with the variation in the ratios of segregation makes it probable that this character is not Mendelian but similar to that already discovered in other plants by BAUR, CORRENS, and IKENO and MILES.

The author proposes to investigate the matter still further by crossing the striped with the normal type.

G. A.

45 - Inheritance of the Character, Crinkly Leaf, in Maize. — EMERSON, R. A., in *The Journal of Heredity*, Vol. XII, No. 6, pp. 267-270, figs. 3, Washington, July 1921.

From crossing a strain of Dent maize with a strain of flint maize, a type with crinkly leaves was obtained in the F_2 generation. The crinkly individuals are usually about $\frac{2}{3}$ the normal height, the tassels are relatively short and compact, and not infrequently bear numerous seeds; often part of the central spike of the tassel is more or less ear-like. The upper leaf-blades are relatively short and broad and frequently have prominent lobes near the base; the crinkles are perpendicular to the median nerve.

Crosses between normal and crinkly individuals invariably give normal F_1 plants, and in the F_2 , normal and crinkly plants in the 3 : 1 ratio.

Therefore probably this character of crinkled leaves depends on a single Mendelian recessive factor according to the scheme of a monohybrid. G. A.

246 - A Sectorial Chimera obtained, by Crossing Two Varieties of Maize in India. -

KHADILKAN, T. R., in *The Journal of Heredity* Vol. XII, No. 6, pp. 284-285, 1 fig. Washington, July 1921.

At the farm of the Agricultural College, Poona, crosses were made in 1920 between two varieties of maize known as Canada Red No. 5 and Amber Pearl pop-corn No. 8, one cob being obtained which duly ripened.

Out of a large number of plants grown from the seeds of this cob there was one in the F_1 generation which grew to the height of 6 feet and had one tiller. One vertical half of the plant and of the tiller was normal, while the other presented the following characters.

1) In all the leaves half the lamina bisected by the mid-ribs was normal; the other bearing yellow and whitish stripes.

2) The leaf-sheaths and stem were also striped in the same manner.

This plant is an excellent instance of sectorial chimera which the author proposes to study further in the F_2 generation. G. A.

247 - A Case of Dimorphism in Rice Connected with Segregation Phenomena. -

PARNELL, F. R., in *Journal of Genetics*, Vol. II, No. 3, pp. 209-212, plate XXI, Cambridge, December 1921.

The inheritance of the so-called *glutinous* character which is typical of a small group of cultivated varieties of rice has been the subject of special study for several years. The glutinous type differs from the ordinary *starchy* type chiefly in forming a sticky mass like glue when it is boiled. Microscopic examination of sections of the two kinds of rice shows no marked difference between them, though they are readily distinguished by their colour reaction. The starchy grains when treated with iodine take on the usual deep blue colour, whereas, the glutinous grains become reddish, passing through wine-colour to dark brown as the strength of the solution is increased.

In inheritance, the glutinous character behaves as a simple recessive, but since double fertilisation takes place, the usual complication of results is obtained. Thus, flowers of a glutinous plant fertilised with starchy pollen produce flowers with starchy endosperm. An F_1 plant on being selfed, bears a mixture of starchy and glutinous grains, giving rise in the F_2 to 3 groups of hybrids bearing respectively: 1) all starchy grains; 2) all glutinous grains; 3) a mixture of starchy and glutinous grains. The two first groups remain constant in the F_2 and succeeding generations, whereas the third produces mixed progeny also formed of 3 groups of individuals.

The mixture of grains in an F_1 plant should give a simple 3 : 1 ratio of starchy to glutinous. In fact on 9 plants, 5292 starchy grains and 1587 glutinous grains were counted (theoretically the figures should have been 5759 and 1720). In the F_2 generation each individual of the three groups

of plants would be expected to give a 1 : 2 : 1 ratio of starchy seeds : mixed seeds : glutinous seeds. In the 81 families so far raised there is a very considerable departure from this ratio in favour of the starchy grains the numbers found being 9211 : 13 729 : 5021, instead of 6990 : 13 980 : 6990 as was expected.

The author has made the important discovery that the F_1 plants have two different types of pollen. One on being treated with iodine, gives the dark blue reaction of ordinary starch, and the other reddish reaction of amylo-dextrine. The pollen of the starchy parent gave the blue reaction and that of the glutinous parent the reddish.

A careful study of the proportion of the 2 types of pollen in the anther (18 anthers from 3 plants having been examined), showed that the proportion of starchy pollen varied from 43.2 % to 51.8 %, the average being 48.1 %.

There can be no doubt that the two types recognisable in the F_1 pollen represent the two genetic types produced by segregation. The author proposes continuing his researches with a view to determining at what stage in spermatogenesis the segregation takes place and considers that this line of work offers distinct possibilities whenever microchemical tests are practicable, especially if such dimorphism can be found in species in which the pollen grains remain united in tetrads.

G. A.

248 - On the Fixity of Characters in New Hybrid Potatoes. — SCHREIBACK, in *Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol. VIII, No. 4, pp. 81-82. Paris, January 1922.

AUMOT, who is continuing his researches on new potato hybrids obtained from seed has found that in certain cases the qualities (characters), of the parents are intensified in the hybrids.

Many of the latter when propagated from naturally fertilised seed have proved very stable.

A hundred individuals belonging to line No. 120 (Beurre × Bolivienne to his 1919) possess all the characters of their parents, luxuriant, strong-growing foliage, the shape and pink skin of Bolivienne to his and the yellow pulp of Beurre.

In 1921 when the ordinary varieties produced tubers for the most part unfit for "seed", the hybrid potatoes were entirely satisfactory in this respect.

Some types were wonderfully resistant to the drought and at the same time very productive. The yield of some of the hybrids raised from seed often exceeded 1 kg. per clump; No. 90, the most prolific, produced 1 300 kg. per clump; some of the tubers weighed as much as 340 gm. each.

These results are really remarkable; they are especially striking, because in 1920, some of the hybrids proved to be immune to *Phytophthora infestans*, which shows that it is possible to obtain types uniting superior qualities with resistance to this destructive parasite.

G. A.

- 249 - **Pure Line Selection of the Bundelkhand Cottons in India.** — BURT B. C. and NIZAMUDDIN HYDER, in *Agricultural Research Institute, Pusa, Bulletin* No. 123, pp. 1-15, Calcutta, 1921.

This paper gives an account of a series of pure line selections made with a view to improving the native cottons of Bundelkhand and of obtaining types of better quality able to resist the excess of moisture in years of heavy rainfall.

Three native cottons were selected for detailed study: *Rath*, *Kulpahar* and *Jalaun*. These were evidently populations made up of types differing greatly as regards flower-colour, leaf-shape, habit-quality, of lint etc.

The two first proved a disappointment, but a good selection, eventually known as J. N. 1, was obtained from *Jalaun*. It had a staple of 0.85" to 0.90", a ginning percentage of 36 % and proved very resistant to adverse atmospheric conditions.

G. A.

- 250 - **Male-Sterility in Flax, Subject to Two Types of Segregation, Ambilateral and Unilateral.** — BATESON, W., and GAIRDNER, A. E., in *Journal of Genetics*, Vol. II, No. 3, pp. 260-275, Plate XXIV, Cambridge, December 1921.

In 1912, a plant of *Linum usitatissimum* was isolated. It differed from the normal type in flowering about 10 days later and its procumbent habit; the stems reached about 2 ft. in length, lying at first flat on the ground, turning upwards as flowering begins and finally standing more or less erect.

This blue-flowered procumbent type was fertilised in 1916 with pollen from a tall white-flowered fibre-flax. The F_1 generation was erect and intermediate both in height and colour.

In the F_2 generation the authors found certain plants having more or less completely aborted anthers. The authors were never completely sterile although sometimes little good pollen was produced. From this pollen a few seeds were obtained by self-fertilisation which gave rise to male-sterile individuals only.

Subsequent experience proved that the new form was brought in by the pollen of the common flax, and that the procumbent is genetically hermaphrodite on both the male and female sides. Twenty-four flax-fibre plants of various kinds, when tested, by using their pollen on male-sterile individuals, gave in all 640 plants all with imperfectly developed anthers. To these 24 plants may be added the white-flowered individual (which had been crossed in 1916 with the procumbent type) and a tall blue plant.

From the evidence of these 26 plants it is to be concluded that the fibre-flaxes are generally if not always heterozygous in respect of the male-sterile allelomorph, and that in segregation, this allelomorph is relegated to the male side.

The procumbent type itself is clearly hemaphrodite in genetic composition; by using the pollen of the procumbent type in crosses with normal flaxes, the authors obtained in F_2 hermaphrodite offspring, and from crosses with the male-sterile type, 101 hermaphrodites and 2 male-steriles.

The latter may safely be assumed to have arisen by self-fertilisation the mother-plant not having been emasculated.

When, however, the procumbent type is used as mother, F_1 is hermaphrodite, and in F_2 the male-steriles appear as 1 in 4. It would appear therefore that the female side of the procumbent must be different in constitution from the female side of ordinary flaxes.

In heterozygosis with the female of the procumbent, the dominant factor for anther-development passes with its negative allelomorph to both the male and female organs of the offspring, thus producing an ordinary Mendelian result. When however the negative allelomorph is in heterozygosis with the female side of the common type, it passes wholly to the pollen of the offspring.

The transmission of characters from one side alone (the paternal or maternal), is a matter of great importance from the genetic standpoint. The authors suggest the term *unilateral* for segregation which carries the allelomorph wholly to one sexual side, and *ambilateral* for the segregation which takes place in ordinary Mendelian distribution. G. A.

151 - Contribution to the Study of Bud Variations of Economic Importance in the Sugar Cane. — BARKER, E. E., in *The Journal of Heredity*, Vol. XII, No. 6, pp. 171-174, fig. 1, Washington, July 1921.

After speaking of the frequent occurrence of bud-variation in the sugar-cane, especially as regards a superficial character like colour, the author dwells upon the importance of making a systematic study of qualitative characters such as sugar content etc., which can only be detected by chemical analyses and experimental tests.

Certain strains of "Cristalina" differ from one another in height and cane-diameter, and consequently in yielding power. Thus cane-fields, even though carefully planted for a single variety, may include more than one strain differing in season of maturity, sugar content of juice and other important economic characters which will affect the financial returns.

As to differences in resistance to disease, there are many noteworthy examples. Yellow Caledonia, Cavangire and Demerara 625 resist the so-called "root-disease" comparatively well, while Otaheite and many others succumb to it. Otaheite, Calancana, Cristalina, and Rayada are most susceptible to gummosis while Yellow Caledonia and Cavangire are strongly resistant, perhaps immune to it.

Otaheite is much injured in Australia by the ravages of the white grub and suffers from the disease known as matizado (mosaic), to which Otaheite and others of the North Indian type of canes are immune. G. A.

1 - Breeding Experiments with Roselle, *Hibiscus Sabdariffa*, in India. — See No. 227 of this Review.

2 - The Possibility of Determining the Value of Seed by Biochemical Means. — NEMEC, A., and DUCHON, F., in *Comptes rendus de l'Académie des Sciences*, Vol. 172, No. 20, pp. 933-935. Paris, November 14, 1921.

The authors have studied the relations between the vitality of seeds and their diastasic activity with a view to ascertaining the possibility of

determining the agricultural value of seeds (especially their germinating capacity and energy), by a rapid and at the same time easy, biochemical method offering greater advantages than the germination test which is sometimes a lengthy process, lasting 5 to 30 days (seeds of forest trees), according to the species.

They have investigated the relations of the various diastases (amylase, invertase, glycerophosphatase, lipodiastase, urease, uricase, phytosterase and catalase of seeds), to the vitality of seeds of different species (maize, white mustard, soy-bean), varieties, and origin.

The results have shown that the action of hydrolysing diastases can survive the germinating capacity of the seed. The catalase behaves in a totally different manner; it would seem that the lost vitality of the organism is intimately connected with the impaired activity of the catalase. It is well-known that this enzyme is extremely sensitive to the hydrogen ion; possibly the chemical changes taking place in the seed, which are characterised by the progressive acidification of the organism, bring about the gradual cessation of the activity of the catalase; in dead seeds the activity seems to be almost completely at an end. The small amount of oxygen released in this case may be attributed to the action of mineral catalysts or to the colloidal substances present in the seed.

It is evident, that the activity of the catalase, as measured by the cubic centimetres of oxygen liberated, affords an excellent means of quickly and easily determining the agricultural value of seeds. The estimate can be made in a few minutes. It only now remains to fix the limits for the practical application of this vital test.

F. D.

254 - **Varieties of Wheat Cultivated in the Province of Cagliari, Sardinia.** — BLANDELL F. (R. Cattedra Ambulante di Agricoltura di Cagliari), in *Italia Agricola*, Year 3, No. 12, pp. 369, 1 coloured plate. Plaisance, December 15, 1921.

The Miocene soils of Trexenda and Marmilla, the alluvial soils of Campidani and Sulcis and the Plateaux of Planargia and Sarcidano, which form the chief wheat-growing areas of the province, produce hard wheat equal in quality to any in the world. Soft varieties are, however, little known, for the few that have been imported ended by becoming hard wheat as a result of the climate, soil and natural intercrossing with the local types.

The Sardinian peasant prefers hard wheat to soft, as it is less inclined to shed its ears or its grain, which allows the harvesting to be protracted which is a great advantage in a relatively sparsely populated region with 25 inhabitants to the square kilometre, of whom only 6 to 7 are peasants.

The variety that best meets the requirements is "trigu murru" (whitish wheat). It is in fact grown on $\frac{4}{5}$ of the wheat area of the province. Afterwards come in descending order, "trigu biancu" (white wheat), "trigu arrubiu" (red wheat) and "trigu moru" black wheat.

TRIGU MURRU. — This variety, when sown from the second fortnight of October to the end of December, according to the season, ripens the first fortnight of June on the coast and in the Campidani, and in the last fortnight of June, or the first fortnight of July, in the hill zone and on the plateau.

It is resistant to lodging and tillers freely: 75 to 80 kg. of seed are planted per hectare.

This wheat is especially adapted for macaroni etc.

Its characters are as follows: ear rectangular, awned, blackish-yellow, 23-25 fertile, closely-growing spikelets.

Spikelets with 3-4 fertile flowers.

Glumes oval, lanceolate, with sharp strong keel; terminates in a short pointed beak, black spots on the edges.

Palea, oval, inflated, terminating in blackish-red awns, that fall off at maturity in favourable seasons, but are otherwise persistent. Seeds oval, slightly convex, pointed, of a fine wheat colour and with straight central section.

Average length 8 mm., breadth 2.5 mm.

Culms full throughout their length, strong.

F. D.

255 - **Experiments with Wheat Varieties in India.** — See No. 227 of this *Review*.

256 - **Mansholt III, a Variety of Oats Resistant to Lodging.** — DESPREZ F. (Directeur de la Station expérimentale agricole de Cappelle, Nord), in *Journal d'Agriculture pratique*, Year I, No. 5, p. 101, Paris, February, 1922.

The author reports the very satisfactory results he has obtained with Mansholt III. This variety of oat was obtained by selection from Victoire de Svalöf by Prof. MANSHOLT of the Royal Netherland College of Wageningen (Holland).

Its chief characteristics are: fairly short, very thick, stiff straw; with panicle; white, plump grain like that of the Victoire variety, but distinctly larger; matures early ripens well in good seasons, the weight per hectolitre is 52 to 53 kg. As Mansholt III does not tiller it must, be sown closer.

"It is an excellent oat, very resistant to lodging; it should not be grown on poor, light soils, but it is very suited to rich, liberally manured land".

F. D.

257 - **The World Production of Soya.** — *Olieën-Vetten en Olievaden*, Year VI, No. 22, p. 251, Amsterdam, November-22, 1921.

The most recent returns for the world's production of soya are as follows (in tons): China 3 352 400; Japan 430 933; Corea 348 000; United States 58 000; total 4 189 333 tons.

In 1918, Japan absorbed 77 % of the Chinese production, America and Europe 7 %, China 16 %.

In 10 years the soya oil exported from China has risen from 25 000 tons to about 400 000 tons. Before the War, this oil was sent to England, the United States, Belgium, Japan, and Russia. During the decade, the exports of soya-cake has increased from 400-500 tons to over 1 million tons.

G. A. B.

258 - **Forage Production in Southern France and North Africa.** — TRABUT, L., in *Le Progrès agricole et viticole*, Year 38, No. 43, pp. 396-398; No. 44, pp. 425-428; No. 45, pp. 451-453. Montpellier, October and November, 1921.

In the opinion of the author these regions could become stock-breeding centres, for they possess a climate that is favourable to the rapid and

luxuriant growth of many species of plants and renders it possible to dispense wholly or at all events to a large extent, with stabulation, greatly to the advantage of the health of the cattle.

As a result of experiments carried on for 25 years, TRABUT is able to state that all the best forage plants that would be useful in Southern France and North Africa have by no means as yet been introduced or exploited to their fullest extent. The family of the Gramineae can furnish a very large number of species suitable for stock-feeding and capable of growing in very different climates. The author in his rapid review especially mentions the following ;

Maize: innumerable forms of this cereal are cultivated ; it would be necessary to choose the best type for each farm ; selection might be of great assistance in this respect.

Euchlaena or *Reana*, known under the name of " Teosinte " a genus nearly-related to maize giving abundant and excellent forage. As the seed is rare and expensive, this plant is not generally grown, but it thrives in the French colonies, and its production might be increased. On irrigated soils, the Teosinte tillers well ; the amount of seed used is relatively small.

Tripsacum: This genus, which came from Central Africa, furnishes perennial forage plants giving a high yield " Zacate prodigio " on the poorer soils of Mexico and Cuba. *Tr. laxum* is still under observation in Algiers. *Tripsacum* can fertilise Teosinte and the resulting hybrid is exactly similar to *Tripsacum*. A plant of this section that might prove interesting is *Coix Lacryma-Jovis*, var *Mayuen*.; in the Far East, it is grown under the name of " Adlay " and bears soft seeds used as a cattle feed ; the straw is plentiful and forms an excellent forage.

Among the different species of *Saccharum*, the Japanese cane grows easily from slips and shoots vigorously throughout the summer until the first cold sets in. In 1920 it yielded 140 tons of forage per hectare at the Ferme Blanche. This plant needs irrigation but can stand a considerable amount of salt in the soil.

S. biflorum quickly attains the height of 3 metres. It supplies a tough forage which is chopped is readily eaten by stock, but it is improved by being made into silage. This plant is propagated by cuttings 30 to 40 cm. in length which are planted in the sand in the spring or autumn. It would be suitable for dunes and a good paper can be made from it.

Mischantus (*Eulalia*), a perennial propagated by cuttings, makes good forage. *M. condensatus*, a Japanese variety, produces heavy crops at the Experiment Stations in Algeria.

The forage sorghums are very numerous. Sudan Sorghum (*Sorghum exiguum* Forsk), has slender stems and makes good hay ; it resists drought well and will produce large crops in summer without irrigation. This plant is also eaten fresh and may be mixed with soya. It requires a certain amount of heat ; must not be sown before April ; tillers well ; 15 kg. of seed per hectare sown in rows are sufficient. *S. exiguum* can be crossed with the other cultivated sorghums but the hybrids, though yielding larger crops, are coarser. Hence it is better to use *S. exiguum*

er hay, and feed the hybrids to stock fresh. Sorghums contain a small amount of hydrocyanic acid; the glucoside giving rise to it disappears in the flowering season and when the plant after cutting has wilted or lack of water. The author has never heard of any bad effects following the use of *S. exiguum* and under favourable conditions this crop can last for several years.

The *Panicaceae* tribe supply a large number of forage species suitable to hot and somewhat arid countries. *P. molle*, *P. maximum* and *P. miliarium* may be mentioned.

The different varieties of *Paspalum*, plants native to America, make excellent forage (*P. virgatum* and *P. dilatatum* where the soil is damp). A few tufts are sufficient to insure its spreading without any fear of invasion. New cuttings of hay can be taken or the field grazed winter and summer.

The various species of *Setaria* (Italian millet, Moha), are very common. The very drought-resistant types from S. Africa and America have yet to be studied. The genus *Pennisetum* has long been known. Two perennial African species are very productive and make excellent forage: *P. purpureum* and *P. Merkeri* (propagated by the Botanic Service of Rhodesia). Most satisfactory results have been obtained from them in Algeria, their crops being much heavier than those produced by the various kinds of maize and sorghum.

P. purpureum is sterile and is propagated either by fragments or cuttings. A cutting planted in April throws up 50 stems over 3 metres in height by October. Thus the plant is propagated very rapidly. The cutting consists of a piece of the stem with an eye; it is put into the ground obliquely.

P. purpureum requires much water and heat. In Cuba, 500 tons per hectare of excellent forage have been obtained from it. The crop at Algiers may be estimated at 250 tons. *P. Merkeri* can be grown without irrigation.

Leersia hexandra which belongs to a genus nearly related to rice and grows wild in North Africa, does well on the banks of rivers or streams. Under the same conditions *Zizania aquatica* produces a heavy forage crop, but its seeds are difficult to keep, the better plan is to plant a few specimens which spread rapidly.

The *Phalaris* are very plentiful throughout the Mediterranean region and often constitute the basis of the forages. *Ph. stenoptera*, of Australian origin and doubtless a hybrid, is an important member of the tribe. It attains a good height, is rust resistant and forms an excellent spring forage being much superior to the native varieties.

The *Agrostis* can be cultivated on damp clay soils.

Excellent results could be obtained from carefully selected varieties of *Phleum*. *Oryzopsis miliacea*, or *Milium multiflorum* is a perennial producing much seed, it stands a high degree of salinity in the soil, is drought resistant and yields 20 to 30 tons per hectare (in several cuttings). *O. homasii* a stronger species which can be used associated with *O. miliacea*, grows on the Côte d'Azur.

Avena sterilis is hardier than *A. sativa* and does well in southern countries. Algerian oats tiller freely and when mixed with Alexandrian clover, form a forage of the first quality in winter and spring.

Cynodon dactylon, the Dog's-tooth Grass can be propagated in the sands; *Chloris Gayana* is however the more satisfactory; it is an African species with a very extensive area (from Tunisia to Rhodesia). This variety of *Chloris* is a perennial; it puts out long stolons that run along the surface of the ground and send down roots at the nodes. Light soils suit this plant best. *C. Gayana* produces a large crop of excellent forage and can be extirpated from any ground it has invaded.

The *Eleusineae* produce large forage crops and bear much seed.

Among the *Festuceae*, *Festuca elatior*, a wild variety, takes the first place. The author reports *F. pratensis* from the northern districts, *F. arundinacea* from the southern and *F. Fenas* from the salt steppes.

Bromus unioloides (Schrader's Brome-Grass), an American variety, produces early forage and stands until the autumn.

In Australia small-seeded wheats (Lambrig) are used for forage.

The many forms of *Lolium* yield good forage. Heavy crops can be obtained in the southern regions from the Leguminosae which should be grown in association with the Gramineae.

P. C.

259 - A New Fodder Grass from Uganda, *Pennisetum polystachyum*. — *Bulletin of the Imperial Institute*, Vol. XIX, No. 3, pp. 295-296. London, 1921.

The grass identified as *Pennisetum polystachyum* Schult. recently submitted to the Imperial Institute, London, for examination with reference to fodder value consisted of plants of pale greenish-straw colour, from 2 to 45 in. long and bearing immature seed heads. The material contains 7.4 % of moisture. The percentage composition is shown as follows expressed on the moisture-free material, in comparison with the corresponding figures recorded for elephant grass (*P. purpureum*) and timothy grass (*Phleum pratense*).

The sample was found to be free from cyanogenetic glucosides.

From the above figures it may be noted that the *P. polystachyum* grass from Uganda contains a slightly higher percentage of protein than the

	Crude protein	Fat	Carbohydrates (by difference)	Fibre	Ash	Nutrient ratio	Food units
<i>Pennisetum polystachyum</i>	9.9 %	2.7 %	38.6 %	40.1 %	8.7 %	1 : 4.5	70
<i>P. purpureum</i>	10.5	1.5	41.4	38.8	7.8	1 : 4.3	71
	7.6	0.8	45.3	38.7	7.6	1 : 6.2	66
<i>Phleum pratense</i>	8.1	3.1	52.6	30.7	5.5	1 : 7.4	81

present in timothy grass and also compares satisfactorily with *P. purpureum*.
M. L. Y.

260 - Cultivation of Lucerne in the Monsoon Districts in India. — See No. 227 of the Review.

[258-260]

161 - **Alfalfa Production under Irrigation (1): Experiments in the United States and in New South Wales.** — I. STEWART, G., Alfalfa production under irrigation in *Utah Agricultural College Experiment Station, Circular No. 45*, pp. 3-48, tables VII, figs. 13. Logan, Utah, May 1921. — II. HARRIS, F. S., and PITTMAN, D. W., The irrigation of alfalfa, in *Ibid. Bulletin 80*, pp. 3-30, figs. 8. Logan, 1921. — III. CHOMLEY, F. G. and CHAPPEY, F. A., Producing Lucerne Hay under Irrigation, in *Dept. of Agriculture New South Wales, Farmers' Bulletin No. 143*, pp. 3-22, figs. 19. Sydney, Oct. 1921.

I-II. — Field and tank experiments on the irrigation of alfalfa were conducted at the Utah Experiment Station, U. S., and apart from the general methods of cultivation employed which are described in detail the following results are worthy of special note.

The best results were obtained when irrigation water was applied in 3 to 5 heavy applications on loams or clay loams, but in 4 to 10 frequent, light applications on porous soils. In these experiments the yield generally increased as the total amount of water applied increased up to 90 acre-inches (the highest amount applied), but the gain in yield from the application of more than 30 acre-inches was too small to pay for the extra labour; 25 in. applied in weekly quantities of 2.5 in. gave better results than 30 in. where 5 in. was applied each alternate week. With an equal amount of water, frequent moderate applications gave better yields than fewer heavy ones.

Where irrigation was not practised, 55 % of the entire yield came from the first cutting and 14 % from the third. Where regular quantities were applied each week, from 33 to 37 % of the crop came from cutting I, from 37-39 % from cutting II and from 25 to 30 % from cutting III.

The relative yields of the different cuttings were to a certain extent changed when the water was applied at various times; but this did not affect the total annual yield consistently.

Apparently the yield was highest when the soil moisture content was kept constantly at 25 %.

III. — Alfalfa growing for hay has for some years become a feature of some importance on the Yanco Experiment Farm in New South Wales, and so profitable that the area has been considerably extended; there are now 120 acres under crop with an average of 6 or 7 cuts per season. Speaking generally, one irrigation for each cut has been found sufficient in the early part of the season, but later an average of two per cutting. Irrigation takes place a week before cutting; a second watering is given as soon as the hay is taken off. A big body of water is never turned on the alfalfa at one time. The head ditch is filled and then a gap is opened in the bank about half way between the check banks, allowing enough water to escape to spread from bank to bank, just covering the surface and moving forward very slowly. It should take from 6-8 hours for the water to reach the lower end of the block 6 chains away, by which time the water can be shut off at the upper end. This method is adaptable to heavy soil but on lighter

(1) See R. Aug. 1917, No. 813; R. May 1918, No. 507; R. Oct. 1918, No. 1082; R. May 1920, No. 496. (Ed.)

soil, the flow can be somewhat faster. It is considered imperative that facilities be provided for thorough surface drainage, as water lying on alfalfa for 3 hours on a hot day will do irreparable damage to the stand.

Apart from the details with regard to irrigation methods employed in New South Wales, the authors give an interesting description of the hay machines etc. used, and certain cultural details.

M. L. V.

262 - **The Chemical Composition of Mangolds. Analyses Made in New South Wales.** - RAMSAY, A. A., in *The Agricultural Gazette of New South Wales*, Vol. XXXII, Pt. II, pp. 819-821, Nov. 1921.

Results of analyses made at Grafton Experimental Farm, Glen Innes Experiment Farm and Hawkesbury Agricultural College, Richmond.

An average of the total analyses made in connection with the recent trials in New South Wales shows the mean composition of the mangol to be as follows: % moisture, 92.01; albuminoids, 0.99; ether extract, 0.04 fibre, 0.77; ash, 1.37, nitrogen free extract, 4.80.

According to the comparison table showing the ranges in variation of composition for all the varieties grown at the 3 different State institutions, and those of English mangels, the ranges in the percentage composition are apparently much greater in the mangels grown in New South Wales. The percentage composition of the dry matter content is also very variable, e. g. albuminoids 7.41 to 22.26 %, ether extract 0.16 to 0.99, fibre 2.28 to 18.86 %, ash 6.74 to 36.38, nitrogen free extract, 32.04 to 83.40 %.

An interesting aspect of the investigations has been a consideration of the variation between the average composition of 8 selected varieties of mangels grown under widely differing conditions, and on the other hand, of the variation when grown alongside one another at any one of the farms. A similar comparative variation is noted as regards the percentage of dry matter content of these 8 varieties shown as follows.

	Variety														
	Sugar	Yellow Globe	Golden Tankard	Mammoth Long Red	Golden Globe	White Sugar Rose Top	Giant Half Green Top	Priewinner	Average	Grafton	Glen Innes	Haw- kesbury	Average		
	%	%	%	%	%	%	%	%	%	%	%	%	%		
Albumin- oids. . .	6.47	5.00	4.12	2.08	7.07	0.50	3.91	3.74	4.11	11.37	7.05	11.67	10.01		
Ether ex- tracts. . .	0.51	0.31	0.64	0.88	0.21	0.22	0.60	0.41	0.47	0.84	0.25	0.66	0.58		
Fibre . . .	16.16	4.29	7.24	8.39	10.56	2.69	7.91	3.73	7.62	6.24	8.51	10.81	8.52		
Ash . . .	18.47	14.95	9.53	9.77	17.42	10.10	12.73	13.03	12.25	8.09	7.78	22.95	12.94		
Nitrogen- free extract	41.61	24.30	18.11	22.06	28.71	10.76	23.75	16.79	23.25	22.81	26.39	31.20	26.81		

M. L. V.

63 - **The Decline in the Yield of Egyptian Cotton and its Causes** (1). — DUDGEON, G. C. (lately Consulting Agriculturist to the Government of Egypt), in *Bulletin of the Imperial Institute*, Vol. XIX, No. 2, pp. 160-174. London, 1921.

In this article attention is drawn to some points which seem to have been generally overlooked, and to correct as far as possible some conclusions which appear to have been formed on insufficient grounds.

A survey is made of the existing state of affairs in Egypt as regards the cotton areas and the yields of former as well as of recent years. With regard to the depreciation in the last 7 years, so many new and unforeseen influences have affected the cotton crop that it is considered hardly possible to regard the conditions as in any way normal. The factors influencing the yield per acre are however considered to fall under 3 important headings and are discussed in the following order: —

1) DETERIORATION OF THE PRODUCTIVE POWERS OF THE SOIL IN COTTON-GROWING AREAS. — *a) Excessive cultivation.* — It is an accepted maxim among Egyptian cultivators that the correct rotation of their crops admits cotton cultivation once every three years *i. e.* only $\frac{1}{3}$ of the cotton growing area or approximately 1 500 000 feddans (2) should bear the crop each year. On reference to the tables it may be noted that from 1905 to 1930 (with the exception of 1915 to 1918 owing to war conditions) this ideal figure had been regularly exceeded, sometimes by as much as 10 % for the whole of Egypt. Consequently the soil ingredients were drawn upon unevenly and the balance of fertility was upset. The fault lies in the fact that advantage has not generally been taken to apply the remedy when the opportunity presented itself, and the recent insuperable difficulties is regards the obtaining of manure.

One of the chief incentives to the practice of excessive cotton cultivation has been the custom of leasing land to tenants on short terms of 3 years. This has been a source of great competition among applicants, and the highest rents are paid to landowners who permit the greatest amount of cotton to be cultivated within the period of the lease. The tenant, having no interest in the land beyond the term of his tenancy, extracts all the cotton possible during that time, but does not attempt to re-establish the fertility of the land for his successor.

This deterioration caused by excessive cultivation could, however, be fully rectified, were it not that other noxious influences have been affecting the soil at the same time.

b) Rise in the Water Table in the Delta (3). — The years in which the cotton production was at its highest were those in which the water-supply was limited by the amount which could be carried by the deep canals, and owing to this limitation the soil drained into the canals when their flow was shut off, and in consequence, did not become sodden. After

(1) See *R.* July 1913, No. 801. (*Ed.*)

(2) 1 feddan = 1.038 acres. (*Ed.*)

(3) See *Movements of Soil Water in an Egyptian Cotton Field*, *R.* Dec. 1913, p. 1323. (*Ed.*)

the Assouan Reservoir began to be drawn upon, much more water became available for irrigation, but the canals ran at a higher level, rendering most of the area to which water had previously to be lifted by great exertions what is termed "free-flow" *i. e.* where, by merely opening a sluice the water runs by gravity on to the land water-logged. The injurious effect on growing cotton was evident. Firstly, the use of water above the root system caused asphyxiation of the roots and produced flower and boll shedding and not infrequently premature death. Secondly, lack of adequate drainage caused a return of noxious salts and the toxic effect was obvious. (1)

The establishment of proper drainage will be gradual, and in certain cases, perhaps unnoticeable for some time, owing possibly to the formation of a condition in the soil similar to «hard-pan» for which additional expedients must be employed to restore fertility.

c) *Insufficient supply of manure and fertilisers, and the introduction of noxious substitutes.* — This is largely due to the unremunerative results obtained with cattle-breeding, and the consequent shortage of farmyard manure.

2) *RAVAGES OF INSECT PESTS.* — The necessity of legislation concerning the pink bollworm (*Gelechia gossypiella*) is a matter of distinct importance (2). The measures instituted to meet the ravages of this new pest are such that, when fully in force a diminution of its numbers may be expected, and as this result implies a retarding of the period of maximum severity, the cotton plants will have a greater opportunity of maturing their late-formed bolls with less injury and of thus increasing their yields.

3) *AGRARIAN DISTURBANCES.* — A short discussion as to the effect of political disturbance etc. on the financial situation with regard to cotton.

M. L. V.

264 — *Cultivation Trials of "patwa" (Hibiscus cannabinus) in India.* — See No. 227 of this Review.

265 — *The Cultivation and Production of the Olive Tree in Spain.* — (3) MARONS, J. (Director of Olive cultivation in Catalonia), in *Revista olearia italiana* Year XII, Nos. 9-12, pp. 144-148, Rome, September-December, 1921.

The author shows the progress made in olive-growing and the olive oil industry in Spain, and emphasises the advantages that would accrue if the Spanish and Italian manufacturers could arrive at some mutual agreement regarding the improvement of the industry and the better utilisation

(1) See *Cairo Scientific Journal*, Vol. II, p. 413, and Vol. V, p. 190, dealing with the salt content of some agricultural drainage waters of Egypt. This shows that where a high water table and no drainage occurred there was a concentration of injurious salts in the surface soil causing it to become useless for cultivation. (Ed.)

(2) See *R.* April 1921, No. 388. (Ed.)

(3) See Prof. Manuel PRIEGO's Original Article: Olive Growing and Production in Spain, in *R.* Dec. 1916, pp. 1727-1733. (Ed.)

of the product. He gives the following data respecting the conditions of olive-growing in Spain.

According to the statistics of 1920-1921, the area under olive-trees is 1 571 294 hectares. It is continually extending and in 1907 the olive yards occupied only 1 353 196 hectares. Olive-growing has increased markedly of late years and owing to the high price paid for olive-oil, agriculturists have transferred their preference from the vine to the olive-tree. The methods of cultivation are not altogether perfect in Spain, but it must be allowed that they are quite as good as the average methods followed in Italy. In some regions, such as a large part of Catalonia and of Aragon, and certain districts of Andalusia, fairly systematic and successful methods are adopted.

In the South specialised olive-yards are preferred. Andalusia and Estremadura are the typical districts of the large, Spanish country estates, some of which occupy 30 000; 40 000; 50 000 and even 60 000 hectares. and it is easy to find there olive yards of several hundred hectares.

In Catalonia on the other hand, where the land is much subdivided, olive-trees are often grown in association with the almond, carob, hazel and vine, or herbaceous crops.

Although some books speak of the irrigation of the olive-tree in Spain, it can fairly be stated that it is only practised in areas of very limited extent. The land capable of irrigation is naturally reserved for other more suitable crops, and the olive-trees that happen to be associated with them benefit by the water supplied.

Olive production has increased with the extension of the cultivated area, and owing to considerable improvements in the methods of cultivation in certain regions, as is shown by the appended Tables.

The industry of preserving olives uses about 350 000 quintals of the fruit annually, viz: 390 197 quintals in 1914; 364 456 quintals in 1916; 377 737 quintals in 1918; 315 930 quintals in 1920.

The finest oil is made chiefly in Catalonia, in the part of the Province adjoining Aragon, at Toledo, and also in some districts of Andalusia. At the present time, it is true that good oil is found more or less everywhere as there are many oil-factories, but the true oil for exportation which is highly prized by the French and Italian merchants, is the Catalonian product coming from Borges, Reus and Tortosa, and also that from Alcañiz (Aragon).

It must be allowed that as a rule, the manufacturing process in Spain is on the same level as in Italy, although in certain regions it is defective owing to the use of superannuated apparatus and old fashioned methods. There are however entire regions of great extent where the plant and treatment leave nothing to be desired and olive oil is produced with an acid content below 0.5 %. Of the 500 000 quintals of oil annually made on the average in Catalonia, at least $\frac{2}{3}$ are of a fine quality suited for exportation. In this Province the fresh or recently-gathered olives are usually but little handled and the oil is extracted without the use of hot water, by being subjected twice in succession to severe pressure. Not infrequently the oil

coming from the presses is very rapidly washed in order to free it more quickly from the water of vegetation.

Of recent years, the co-operative oil-factories have greatly developed especially in Catalonia, and hence the improvement in the quality of the output. At the present time there are 30 factories in this region producing some 50 000 quintals of olive-oil. The three or four largest factories each handle some 200 quintals of olives. Their plant and methods are thoroughly up to date.

TABLE I. — *Production of Olives and Olive-oil in Spain during the Period 1908-1920.*

Years	Olives	Olive-Oil
	quintals	quintals
1908	8 277 174	1 518 895
1909	13 928 938	2 397 720
1910	6 246 189	1 085 088
1911	22 195 164	4 217 826
1912	3 553 310	630 012
1913	14 868 745	2 654 225
1914	11 814 306	2 077 649
1915	17 728 868	3 261 079
1916	11 465 980	2 071 150
1917	22 077 001	4 278 376
1918	14 038 314	2 552 023
1919	18 130 999	3 363 937
1920	16623 845	3 169 637

TABLE II. — *Oil Production of the different Regions of Spain in 1920-1921*

	Areas	Oil Produced
	hectares	quintals
New Castile	111 335	336 958
Old Castile	6 830	21 085
La Mancha and Estremadura	175 726	172 408
Leon	4 241	2 450
Aragon	56 078	216 694
Navarre and Rioja	15 734	11 632
Galicia	214	272
Catalonia	514 760	476 566
Levant (Valencia)	118 820	196 155
East Andalusia	367 172	925 118
West Andalusia	500 304	807 379

The great variations between the output of oil in different years are due to the spread of diseases or of parasites. The most formidable of the latter in Spain, as elsewhere is the Olive Fly (*Dacus oleae*) Meig. As a means of control efforts are now being made to popularise the LOTRIONTE method which was widely tested in Catalonia in 1920.

F. D.

266 - **Illipe Nuts of British North Borneo from *Shorea stenoptera* and other Dipterocarps.** — *Bulletin of the Imperial Institute*. Vol. XIX, No. 2, pp. 140-142. London, 1921.

The "illipi" nuts of British North Borneo are quite distinct from those of India which are obtained from species of *Bassia* (Nat. Order. Sapotaceae). A full account of the different forms of the Borneo nuts derived from various dipterocarp trees, with the results of examination at the Imperial Institute is given in a previous publication (*Bulletin of the Imperial Institute*, Vol. 13, No. 3, pp. 335, 1915). Since then a quantity of kernels have been forwarded recently for investigation and the results are here given. The kernels were stated to have been obtained from nuts collected in the Kinabatangan district and washed in sea water.

The kernels were found to contain 6.9 % moisture, and to yield, on extraction with light petroleum, 44.8 % of fat, corresponding to a yield of 48.1 % from the moisture free kernels. The fat was a greenish-yellow solid with a faint odour and on examination gave the following results:—specific gravity at 15° C, 0.8551; refractive index at 40° C, 1.456; solidifying point of fatty acids, 52.5° C; melting point of fat 34° C; acid value 11.4; saponification value (mgm. of potash per 1 gm. oil) 192.4; iodine value % 2.2; unsaponifiable matter % 0.6; volatile acids, soluble 0.1 and insoluble 0.4 cc. of decinormal alkali required to neutralise acid from 5 gm. of oil. A comparison is made with the results obtained with a previous sample of illipe fat and with figures previously recorded for Borneo tallow.

The residual meal left after the extraction of the fat from the kernels was yellowish brown and had a faint bitter taste. The results of analysis are as follows: % moisture 10.9, crude proteins 10.3, fat 7.8, carbohydrates etc. (by difference) 64.5, crude fibre 3.2, ash 3.3, nutrient value 1: 8.0 and food units 110. (A comparison is given of figures recorded previously or illipe cake").

The meal contained no alkaloids or cyanogenetic glucosides.

These kernels represented the brown variety and contained 48 % of oil in the dry material, which is about the usual yield.

It is stated that in spite of the somewhat low percentage of protein (11.3 %) in the residual meal which renders it a less valuable foodstuff than palm-kernel cake (16 %), the illipe meal has already proved its value commercially.

M. L. Y.

267 - **The Value of the Oil of the Physic or Purging Nut (*Jatropha Curcas*) and Utilisation of the Residual Cake as Manure.** — *Bulletin of the Imperial Institute*, Vol. XIX, No. 3, pp. 288-291. London, 1921.

The evergreen shrub *Jatropha Curcas* Linn. (N. O. Euphorbiaceae) is indigenous to South America but has been introduced into most tropical countries. Apart from the purgative and emetic properties of the oil obtained from the seeds and its utilisation for soap manufacture (a fact proved at Lisbon on receipt of seeds from Portuguese Africa), suggestions have also been made as to its possible value as a lubricant to replace castor oil.

Seeds from South Africa and the Gold Coast were examined at the Im-

perial Institute, London, and consisted respectively of shell 39 and 33 %, kernel 61 and 67 %, moisture in seed 7.9 and 11.1 %, yield of oil 31.9 and 33 % and yield of oil expressed on dry seed, 34.6 and 37 %.

An analytical comparison is made between these oils and oil from Nigerian seed examined previously (*Bulletin of the Imperial Institute*, 1904, Vol. 2, p. 170).

To test the value of curcas oil as a lubricant, viscosity tests were carried out with the oil samples and an interesting comparison is made with a commercial sample of castor oil as follows (viscosity in seconds for 50 cc. at 70° F): Gold Coast sample 1; 298; sample 2; 290; South Africa 284, castor oil 3888.

All these samples were also exposed in thin films on glass under varying conditions and according to the results obtained, it is evident that curcas oil differs widely in viscosity and drying properties from castor oil and dried more rapidly when exposed to high temperature and to light and air. For certain types of machinery therefore for which castor oil is particularly suited as a lubricator, curcas oil could not be used with advantage.

Examination of the residual oil cake sent from Zanzibar, prepared from undecorticated seed proved on analysis that the cake has a high value as a manure, being approximately as rich as castor-seed cake in nitrogen and phosphoric acid. It is suggested that the ash obtained on burning the cake would form a valuable concentrated manure, or the potash might be extracted and utilised locally for soap-making. The following percentage composition was determined: moisture 10.4, nitrogen 3.2, phosphoric acid 1.4, potash 1.2, soda 0.21, chlorine 0.13, sulphuric acid 0.08, ash 5.6. The ash contained: phosphoric acid 25.7, potash 20.7, soda 3.8, chlorine 2.4, sulphuric acid 1.5.

In consideration of the fact that the residual cake or meal has purgative properties and could not be utilised as a feeding stuff, but only as a manure, it would doubtless realise a relatively low price. M. L. Y.

268 - **Economic Value of the Seeds of *Carthamus* spp. and their Oil Product.** — See No. 227 of this Review.

269 - **Observations on the Cultivation of Java Indigo at Pusa, India.** — See No. 217 of this Review.

270 - **The Qualities of Java Seedling Sugar Canes and suggested Introduction into Louisiana U. S. A.** — Cross, W. E., *Revista Industrial y Agrícola de Tucuman*, Vol. XI, Nos. 9-10, pp. 118-121, Buenos Ayres, 1921, and in *International Sugar Journal*, Vol. XXIII, No. 265, pp. 614-616, London, Nov. 1921.

The seedling varieties under discussion were produced in Java by crossing the Cheribon cane with the variety Chunnee which grows freely in northern India under generally adverse conditions. These hybrids POJ 36 and POJ 213, combine the qualities of the two parents, being rich in sugar like the Cheribon and very vigorous and highly resistant to disease and frost damage like the Chunnee. For sub-tropical conditions, they are among the best varieties at present known.

It has been noted that although Louisiana U. S. possesses more favourable conditions for cane cultivation than Tucumán (Argentina), only one-year ratoon crop is obtained and it is necessary to practise a rigorous system of rotation, ploughing under leguminous crops one year in every three. In addition to this, considerable quantities of commercial fertilisers have to be applied. — Tucumán on the other hand obtains ratoon crops up to 7 or 8 years, gives little or no attention to the question of crop rotation, uses no fertilisers and obtains with the Java seedling canes better yields of cane and sugar than is generally the case in Louisiana. It is therefore recommended that Louisiana planters might introduce and study these seedlings to their commercial advantage. A summary is given of the qualities of the two Java seedlings POJ 36 and 213 as follows: —

1) Vigorous varieties of great ratooning power, giving heavy yields. The limiting factor in Tucumán is the low annual rainfall; in Louisiana this limiting factor disappears.

2) Low cost of cultivation, as they grow very rapidly in spring, Louisiana has the advantage of earlier spring rains than Tucumán, hence early development would be much more marked.

3) Very resistant to the cane borer (*Diatraea saccharalis*). As a point of comparison it may be noted that this was a very serious pest of the Cheribon cane.

4) Much more resistant to frost damage than the Cheribon and the 74, and would probably enable the harvest period to be deferred to a later date, thus eliminating the disastrous effects produced on the stubbles by early cutting and enabling the factories to obtain riper cane for grinding purposes than at present.

5) More resistant to root disease (*Marasmius Sacchari*) and mosaic.

6) Greater resistance to the rotting of the stubbles during the winter. The advantage of introducing these seedlings into a country where the winters are moist e. g. Louisiana, is therefore evident, seeing that the cane from the first year's stubble has up till now been less than the plant cane, and the second year's stubble has given so small a yield as not to be worth cultivating.

7) Much more fibrous than the Cheribon, containing an average of 2.5 % fibre compared with 10.0 or 10.5 % for the latter. This allows for a higher sucrose extraction from the same mill and diminishes the cost of fuel.

M. L. Y.

71 - Tests of New Methods of Propagating the Sugar-Cane in Cuba. — CALVINO, M., in *Revista de Agricultura, Comercio y Trabajo*, Year IV, pp. 500-503, figs. 2. Havana, 1927.

At the Agricultural Station of Cuba the author has tested the method of propagating sugar-cane which was recommended for India, by KULKARNI (1). This consists of cutting the cane into setts of 3 nodes (taking them from the middle node and the two last nodes), and of removing all the eye-buds, except the one of the middle node. The sett should be planted, so that the eye-

(1) See R. March 1920, No. 327. (Ed.)

bud points upwards; in this way a much more vigorous tuft of sugar-cane is obtained than if the eye-bud pointed downwards.

The results were perfectly satisfactory, as is seen from the following comparative data.

Yield in kg. per Hectare.

Variety	Sett with one eye-bud	Sett with all its eye-buds
D 74	68 690	63 790
D 99	71 150	61 330
D 108	24 529	23 310
Uba	82 800	75 440
Cristalina	46 000	36 800

This system can be improved by adopting the practice (devised in Cuba by ABREN and recommended for India by VENKATRAMAN) of letting the setts bud before planting them out, thus giving an opportunity for choosing the most vigorous shoots.

A frame of bamboo is erected at a convenient height above the ground say 90 cm., and upon it is spread a thin layer of straw which is soaked with dung mixed with a little water. The setts are first dipped in a mixture of dung and water and then piled up roughly on the frame, so that they form heaps, the setts crossing each other in every direction, thus allowing free access to the air. The small heaps are in their turn covered with a layer of straw soaked as before in a mixture of dung, the whole being kept moist by repeated and careful watering.

The increased yield fully compensates for the larger number of workers required. Sometimes, however, lack of labour makes it impossible for the process to be carried out on a large scale, in which case only the cutting destined for the plantations reserved for propagation can be thus treated.

F. D.

LIVE STOCK AND BREEDING.

HYGIENE

- 272 - *Helenium Hoopesii*, a Poisonous Plant harmful to Stock in Utah, U.S. - MARSH, D. W. (Physiologist in Charge of Investigations of Stock Poisoning by Plants), CLAWSON, A. B., (Physiologist), COUCH, J. F. (Pharmacological Chemist), and MARSH II. (Veterinary Inspector, Bureau of Animal Industry), in *United States Department of Agriculture, Bulletin No. 947*, pp. 1-46, tables 13, bibliography of 13 works. Washington D. C., Oct. 11, 1921.

The "western sneezeweed" (*Helenium [Dugaldia] Hoopesii*) has become very abundant on some of the more elevated and overgrazed stock ranges of the western United States, especially in Utah. It is found in the yellow pine belt, grows also in the aspen and spruce belts and sometimes reaches the arctic alpine zone.

[271-272]

Feeding experiments carried on at the Salina Experiment Station in Utah with sheep and cattle showed that this plant was the cause of the so-called "spewing sickness" of sheep, and cattle also to a certain extent suffered from poisoning.

The symptoms produced by the plant, the pathology and the toxic sage were all studied in detail. The poisonous principle is an easily composed glucoside ("dugaldin") which proves toxic when received orally, intravenously, subcutaneously or by the rectum.

The most marked symptoms are general depression, weak pulse, risea followed or not by more or less chronic vomiting. Death is not accompanied by convulsions.

No effective medicinal remedy has so far been found. As to the possibility of exterminating the plant, experiments in scythe cutting proved of no avail and experiments are in progress to test the effect produced by restriction of grazing and allowing the range to reseed itself and so as to the possible extirpation of *H. hoopesii* owing to the growth of grasses and weeds.

M. L. Y.

3 - Use of Stomosines in the Treatment of Infectious Diseases of Live Stock. — CENTANNI, E., in *L'Italia Agricola*, Year 58, No. 12, pp. 366-368. Piansance, December 15, 1921.

Stomosines are immunising substances discovered by the author which differ from those hitherto known (serums and vaccines). The latter have preventive and the former a curative effect; they contain in an innocuous form the principle that destroys the micro-organisms and their poisons.

When the preparation of serums was extended to all infectious diseases, unmountable difficulties were experienced owing to the different kinds of poisons produced by bacteria and the various ways of neutralising them.

Bacteria are the cause of two distinct sorts of poison, true specific toxins and aspecific endotoxins. The first are the product of a very small number of the least common bacteria consisting almost exclusively of the pathogenic agents of tetanus and diphtheria; in the case of all the others, the fundamental poison causing the complex of the symptoms is an endotoxin. Once it is impossible to make immunising serums against endotoxins, it may fairly be said that a serotherapeutic has found itself disarmed in the case of most infectious diseases and is unable to intervene with any prospect of success when once the syndrome has declared itself.

In trying to discover what defensive means the organism adopts during the course of the disease, in order to free itself from these poisons and gain health, the author found that the active agent is a ferment or rather kinase, increasing the activity of the ferments and so constituted that the endotoxins are attacked and burnt, being thus quickly reduced to inoffensive substances.

The author has given the name of "stomosine" to this kinase, which is prepared and isolated by means of chemical processes, taking as his point of departure the protein-bacterial principles arising from the micro-organisms inducing the disease.

The poisons disseminated by the bacteria installed in the organism have two ways of manifesting themselves. Those carried by the blood produce the syndrome of fever and all the local troubles accompanying it (abscesses, sores, ulcers etc.), while the others cause the complex of symptoms resulting in the irritation and inflammation of the tissues surrounding the centre of infection. As is required by this double symptomatology, the action of the stomosines is also twofold, being both general and local.

Shortly after infection, which is followed by violent shivering, a rise of temperature takes place (average 1° to 1.5°C) showing that the combustion of the infected matters has begun. The temperature remains at this level for 8-10 hours and then suddenly falls (the change being accompanied by profuse sweating) to normal, or nearly normal. If the effect is complete, a single injection is enough to produce a cure. Sometimes, however, it is necessary to repeat the operation two or three times to obtain definitive results. In some of the most resistant cases, the disease becomes of a benign character.

The effect upon the local centre is similarly explained: the irritant poisons are destroyed and therefore all the symptoms of inflammation (congestion, exudations, pain), are removed, the surface becomes healthy and cicatrization rapidly takes place.

So far stomosines have been prepared for the chief infectious diseases of cattle (epizootic foot-and-mouth disease, diarrhoea in calves, polyarthrititis and septic pneumonia); of pigs (swine fever, septicaemia, paratyphus and measles); of horses (equine adenitis, colt polyarthrititis) and of poultry (fowl cholera and avian pest).

Even where the pathogenetic agent is an invisible virus that cannot be cultivated, the effect of the stomosine is satisfactory, probably because also under such a form the actual toxic factor is an intermediate poison of the nature of an endotoxin. This is the case with the virus of epizootic foot-and-mouth disease, swine fever and avian pest; all these diseases and especially swine fever, have proved amenable to stomosine treatment.

Stomosines are agents of an essentially curative character; as soon as they are introduced into the organism, they find themselves in the presence of poisons and bacteria which they attack and render powerless as described above. If, as in the case of preventive infection in a healthy organism they encounter no pathological element, they remain in the circulatory system, but their power decreases somewhat rapidly in the course of a few days.

Their true use is to effect a cure, and they act even if introduced when the disease is in full development, or actually far advanced, but to obtain a more certain result, they should be employed as soon as the malady first declares itself. If an outbreak of epizootic disease occurs in a stable, not only the first animal attacked should be treated but also all the animals that have been in contact with it, in order to interrupt the incubation of the disease or prevent its occurrence.

Should the disease have made its appearance in the neighbouring stables, a general preventive treatment must at once be begun in all the

threatened stables without waiting for it to assume an epidemic form. In order to prolong the protection, seeing that the immunisation is not of very long duration, the injection ought to be repeated on an average every fortnight, as long as any danger threatens; in this way the owner may be sure that his stock will entirely escape infection or that the disease will assume a benign form in any of the animals attacked.

Stomosine is supplied in two forms: a) liquid for immediate use, b) as a soluble sterilised powder for keeping a long time. The average dose is from 5 to 10 cc. per quintal of weight. The most effective way of using it is in the form of an intravenous injection; this induces the largest number of instantaneous crises and should be adopted for very urgent cases. In ordinary cases since the liquid diffuses very readily, a subcutaneous injection is all that is required. The injection has never produced bad effects, for the substance of which it is composed is an elective kinase without any toxic or anaphylactic action.

F. D.

274 - **Protozoan Parasites of Domestic Animals in Transcaucasia.** — JAKIMOFF, W. L., in *Bulletin de la Société de Pathologie exotique*, Vol. XIV, No. 10, p. 652. Paris, December 14, 1921.

In the Chemical and Bacteriological Laboratory of the Malaria-epidemic Mission of the Union of the Russian Zemstvos (which has its Headquarters at Prokhladnoë near Kars), the author and his collaborators found the following protozoan parasites: in cattle, *Piroplasma bigemum* (peripheral blood); *Sarcocystis blanchardii* (peripheral blood and blood of heart); *Trypanosoma theileri*; in camels from the Government of Sakaspisk, the author's colleagues, the veterinary surgeon, JLINE and Dr. SOULINA SAMAILLO found *Trypanosoma Ninae* Kohl-Jakinoff which the author had already met with in 1913, in the camels of Turkestan (1).

No microfilariae, or endoglobular parasites were discovered either in the horses or dogs.

F. D.

275 - **Researches on the Mite-Destroying Power of some Substances used against Parasitic Mange in Horses.** — HENRY, A., in *Recueil de Médecine vétérinaire*, Vol. XCVII, No. 18, pp. 358-370. Paris, September 1921.

In order to test the various substances used as remedies against parasitic horse-mange the author made use of the methods most commonly employed which consists in placing the parasite (sarcoptes or psoroptes) in contact with the substance and observing under the microscope how soon the insect dies, or rather how long it can live, its resistance being proportionate to the activity of the acaricide. As a counter-test (to determine if death is real or only apparent and a reflex protective device,

(1) In Russia in Europe (Government of Astrakhan), the trypanosomes of the camel were found in 1912 and in Russian Turkestan and the Ural in 1913 and 1914 respectively. W. L. JAKIMOFF and M. le W. J. WASSILEWSKY (*Bulletin de la Société de Pathologie exotique*, Vol. XIV, No. 10, pp. 637-640) have established the identity of the Turkestan and Ural trypanosomes. The researches made by MESNIL at JAKIMOFF's request, have proved that these trypanosomes differ from those of "surra" (*Trypanosoma evansi*), and of "debab" (*Trypanosoma sudanensis*).

Acaricide power of certain substances.

Substances	Acaricid power
10 % Aqueous solution of potassium polysulphide	very weak
" " " sodium monosulphide	0.083
" " " calcium sulphide	very weak
Carbon bisulphide (1)	2.5
Flowers of sulphur; sulphur precipitated by potassium polysulphide; sulphur precipitated by hyposulphite of soda; HELMERICH'S ointment (formula of St. Louis hospital)	very weak, if any
Sulphurous acid 1 % solution in oil	1
Idem 2.5-5-10 % solution in oil	5
Idem 1 % "	0.5
Idem 2.5 % "	2
Idem 5-10 % "	5
Idem 5 % aqueous solution (2)	0.33
Idem in pure gaseous condition 4.5-5 %	0.25 to 0.33
Idem impure (gas from combustion of sulphur 4-5 %)	0.33
Arsenic acid, aqueous solution obtained by heading	0.008
Sodium arsenate, aqueous solution	weak
Double mercurial ointment	very weak
Benzine in closed vessel	0.33
Nitrobenzine	1
Nitrobenzine 10 % solution in oil	0.166
Nitrobenzine fumes: 10 gm. per cubic metre	0.25
Xylene fumes: 10 gm. per cubic metre	0.50
Gaseous formaldehyde	none
Pure spirits of turpentine	0.20
Pure beech creosote.	2.5
Creosote solution, 10 % in oil	0.33
Oil of cade, pure.	0.20
Coal-tar oil, pure.	1
Paraffin	0.055
Petroleum, heavy.	none
Petrol	0.041
Sulpho-paraffin ointment	very weak
H. P. B. mixture: 2 parts oil + 1 part petroleum + 1 part benzene	none
Emulsion: Carbonate of soda 100 gm. + 4 litres water + 1 litre petroleum	very weak
Cresyl, ordinary, pure.	2.5
Cresyl, 2.5 % aqueous solution	0.5
Lysol, 2.5 % aqueous solution	0.33 - 0.25
DESCAZEAU bath: Cresyl 25 + arsenic acid 1 + polysulph. of potassium 6 + carbonate of soda 10 + water 1000 (parts by weight)	0.5
10 % cresylated oil	0.2
Balsam of Peru, pure	0.25

(1) Cannot be applied to the skin of a horse.

(2) Useless in quantities below 5 % : water destroys much of the acaricide power of sulphurous acid.

as the author express it), the dead or apparently dead mites are put into peanut oil at 30-32° C, an artificial medium considered the most suitable by the author, seeing that the parasites are able to live in it for several days without any inhibition of some of their functions. The author defines the unit of acaricide power as the capacity for killing psoric mites in 5 minutes at the temperature of 30-32° C. Thus, beech creosote which kills the mites in 2 minutes, has an acaricide power of 2.5; pea-nut oil dissolving sulphurous acid in the proportion of 1% (by weight), has an acaricide power equal to unity, because it kills the psoric mites in 5 minutes at 30-32° C; and a 2% aqueous emulsion of cresyl destroying the mites in 10 minutes has an acaricide power of 0.50.

The other substances tested gave the results set out in the following Table. The author draws from them the following conclusions which are of practical importance.

1) Sulphurous acid dissolved in oil proves to be the most effective acaricide (it is not necessary to increase the saturation beyond 2.5%; as this does not make the activity greater).

2) A 1 or 2% warm or tepid, aqueous emulsion of cresyl is the most energetic anti-acarian disinfectant.

F. D.

276 - **A New Disease of Oxen: Contagious Acute Encephalitis.** — DONATIEN, A. and ROSSELUT, R., in *Comptes rendus de l'Académie des Sciences*, Vol. 174, No. 4, pp. 250-252 Paris, January 23, 1922.

The authors report a contagious disease that during the autumn of 1921 carried off 9 of the oxen in a herd belonging to a farm near Algiers. The symptoms of the disease were signs of madness and abundant salivation; there were no actual lesions.

Experimental research showed, that it was a contagious complaint transmissible in series to the ox, rabbit and guinea-pig. It is due to a new neurotropic virus which should probably be placed in the same category as the human diseases, encephalitis lethargica and acute anterior poliomyelitis.

F. D.

277 - **Vaccination of Cattle against Rinderpest.** — NICOLAS, E., and RINJARD, P., in *Comptes rendus de l'Académie des Sciences*, Vol. 173, No. 25, pp. 1428-1429. Paris, December 19, 1921.

The countries where rinderpest has become endemic (Eastern Europe, Asia and Africa) cattle are inoculated against this fatal malady according to KOLLE and TURNER's method which has now become universal. This method consists of infecting, at the same time and into two different places, a small quantity of virulent blood, 0.2 cc., to 1 c.c., or more (taken from an animal suffering from rinderpest, and at the height of the fever-period), and also anti-rinderpest serum in proportions varying according to the activity of the serum and to the size of the animal to be vaccinated. The amount must however be sufficient to insure that this double simultaneous infection, which is a real sero-infection, shall be followed by a "good reaction", that is to say one that after a short incubation period, lasting usually 3 to 5 days, results only in a rise of temperature that may regis-

ter as much as 40° C and is quite compatible with a satisfactory condition of health, for no lesions of the mucous membranes are developed although a slight degree of lachrymosis is frequently present. After, such a reaction the animals are as effectively and durably immunised as if they had recovered from the disease.

When well carried out this method gives excellent results, fatal effects being most rare; it has, however, one serious drawback, that of producing in the inoculated animal a reaction that not only has the appearance of rinderpest, but is actually due to an attenuated form of the disease. Hence the vaccinated individual becomes a source of infection to healthy animals capable of contracting the malady, so that if care is not taken this method increases the sources of virus and becomes a means of spreading and perpetuating rinderpest.

This evil can be remedied by vaccinating in zones, but it is possible greatly to lessen, and perhaps, cause it to disappear, by increasing the amount of serum injected, so as to effect a "silent" vaccination. This seems to be proved by the results of experiments observed by the authors during the course of the Mission to Belgium with which they were entrusted during the epidemic of 1920.

They certainly found on various occasions, that by using the right doses of serum of which the effect has been ascertained by comparison with that of a known virus, it is possible to avoid producing any external symptoms that can be detected by the examination of the patients. Vaccination was however attained, as was shown by the fact that the test experiment with pure virus had no effect, any more than the subsequent injections of large quantities of virulent blood which were made with a view to hyper-immunisation.

This being the case it is probable that active vaccination, "silent" in so far that it produces no apparent reaction on new subjects, cannot create a dangerous centre of infection in the zone where it is carried out. This form of vaccination will therefore be the one most usually adopted.

F. D.

278 - Summary of Experiments on Foot-and-Mouth Disease (1) in France. -

ROUX, E., VALLÉE, H., CARRÉ, H. and NOCARD (the late), in *Comptes rendus de l'Académie des Sciences*, Vol. 173, No. 23, pp. 1141-1145. Paris, December 5, 1921.

At the request of the French Government, the authors have been making researches on foot-and-mouth disease. Their work, which was begun in 1901, was only interrupted during the period of the War.

In the paper analysed they give a summary of the results of their investigations.

Like LÖFFLER and FROSCH they used young pigs (as being susceptible animals) for preserving the aphthous virus by means of successive transmissions. Between each transmission, the virus is kept in a refrigerator

(1) For other studies on epizootic foot-and-mouth disease, see R. 1911, Nos. 590, 2197, 2783; R. 1913, No. 954; R. 1916, Nos. 661 and 768; R. 1919, No. 923; R. 1920, Nos. 335 and 882; R. 1921, Nos. 309, 734, 735, 829 and 1019. (Ed.)

temperatures below 0° C. This method has the defect of only providing limited supplies of virus.

The lymph from the vesicles and the serous liquid retain their virulence intact for no more than 3 weeks in the refrigerator; further, the lymph is bacteriologically impure.

As a source of virus, blood taken from infected heifers during the time their temperature is rising is far preferable. The authors use no anti-coagulants in their technique, substituting for them mechanical defibrination. The preservation of the virulence of the defibrinated blood is actually insured for 2 to 3 months if the blood is kept at temperatures varying from -10° C to $+20^{\circ}$ C.

The accidental introduction of extraneous matter seems to have no effect upon the keeping-qualities of the virus; it is however injured by filtration.

Pounded fragments of the desquamated epithelium and lymph from the vesicles are infectious after dilution to 1/20 000. The issues from the pericardium retain their virulence to 1/1000, whereas blood serum ceases its regular pathogenetic action, if inoculated in amounts of less than 0.2 cc.

It is a mistake as has been found by the authors, to regard aphthic virus as easily destroyed. Desiccation for instance does not exercise the deleterious effect that was supposed.

With the exception of intradermic and intramuscular inoculation, which specially when substances containing foreign matter difficult of absorption are employed) are very severe methods of introducing the virus, and also of the frequently dangerous process of intra-venous inoculation, all the experimental methods of aphthic infection are incomparably less severe than the forms of natural contagion.

Already over 30 years ago, NOSOTTI (*Clinica veterinaria*, 1885, p. 101) considered the question of immunisation by the sub-cutaneous inoculation of virulent lymph.

The author studied the question from the beginning of their researches, and the results of their investigations as to the most favourable conditions for the re-absorption of the aphthic virus led them to use for subcutaneous infection clear, virulent, blood-serum that had been fixed by remaining a month in the refrigerator. The dose to be injected beneath the skin must not be less than 1 cc. Larger amounts are sometimes troublesome. When carried out properly, experimentally induced foot-and-mouth disease always causes the development of the malady in the mouth-cavity.

Artificial anti-aphthic immunity is not lasting, and disappears in less than 6 months, even in hyper-vaccinated animals. This gives little hope that the problem of anti-aphthic immunisation will ever be completely solved.

F. D.

9 - Intestinal Coccidiosis of the Pig. — CAUCHEMEZ, L., in *Bulletin de la Société de Pathologie exotique*, Vol. XIV, No. 10, pp. 643-648, fig. 1. Paris, December 14, 1921.

From researches at the Laboratory of Parasitology of the Faculty of Medicine in Paris and at the Laboratory of the Vaugirard Abattoir,

the author has discovered that intestinal coccidiosis is a disease of very frequent occurrence in swine, 26 % of the animals examined being found to be affected. The disease assumes a mild form in adult pigs causing no disturbances or lesions. Its presence may, however, serve to explain serious intestinal affections in quite young pigs. If the latter are attacked by a mild form of coccidiosis, they soon recover and have been rendered immune to the malady. There is but little literature on the subject and in the absence of all experiments of reciprocal immunity, it is impossible to say whether the coccidiosis of cattle and swine is identical. The author proposes the provisional name of *Eimeria brumpti* for the pathogenetic agent in swine coccidiosis. It differs from the 3 species of parasite attacking man and identified by C. DOBELL as belonging to the genus *Eimeria* and there is therefore no reason to suppose that swine coccidiosis can be transmitted to human beings. F. D.

280 - **Experimental Studies on the Systematic Use of Food for Cattle in the United States.** — I. TROWBRIDGE, P. F., MOULTON, C. R., and HAIGH, L. D., in *University of Missouri, College of Agriculture, Agricultural Experiment Station, Research Bulletin* 25, pp. 129, tables 55, figs. 26, Columbia, Missouri, 1918. — II. TROWBRIDGE, P. F., MOULTON, C. R., HAIGH, L. D., *Ibidem, Research Bulletin*, No. 30, pp. 106, tables 68, figs. 25, 1919. — HAIGH, L. D., MOULTON, C. R. and TROWBRIDGE, P. F., *Ibidem, Research Bulletin*, No. 38, pp. 47, tables 45, 1 plate, 1920. — IV. ECKLES, C., H. *Ibidem, Research Bulletin*, No. 36, pp. 20, tables 7, figs. 5, 1920. — V. MOULTON, C. R. TROWBRIDGE, P. F., and HAIGH, L. D., *Ibidem, Research Bulletin*, No. 43, pp. 111, tables 57, figs. 30, 1921.

I. — **EFFECT OF LIMITED FOOD ON GROWTH OF BEEF ANIMALS.** — The objects of these experiments were to determine: 1) if an immature animal can use its stored fat to protect growth when sparsely nourished and to what extent the body fat may be relied upon to insure the continuation of growth; 2) the changes that occur in the composition of the bodies of immature animals when kept for a considerable time on a so-called maintenance ration, and also the changes that take place when such animals are kept on a ration above maintenance, but insufficient to supply the maximum growth of which the animal is capable. This work is of practical importance for it is a common habit among many farmers to bring young cattle through the winter with practically no gain in weight, so that these animals make a very marked skeletal growth and become very thin.

In October 1907, a number of closely related steer calves that had been dropped early in the preceding spring were taken and put on a liberal feed. Seven thrifty yearling animals were later selected from among them, and 6 were given the experiment rations, 3 for 6 months and 3 for 12 months. They were afterwards slaughtered and analysed. The 7th was slaughtered and analysed at the outset of the experiment and used as a check animal, the composition of its body being taken as representative of that of the other animals at the beginning of the experiment. Of the remaining steers (Nos. 593 and 599), the fattest and thriest, were fed so as to gain $\frac{1}{2}$ lb. per head per day; Nos. 597 and 595 received a ration producing no

hange in their weight, and the thinnest pair (Nos. 591 and 592), were ed to lose $\frac{1}{2}$ lb. per head per day.

At the beginning of the experiment (February 25, 1908) the calves were rom 9 to 12 months old. The same ration was supplied to all the animals, he only variation being in quantity. The grain (maize chop 8 parts, inseed meal 1 part) was fed twice daily in equal amounts, the hay was ed at night only and was $\frac{4}{10}$ as much as the daily grain ration. One nimal of each group (Nos. 591, 597 and 593), was slaughtered on September . In November a digestion trial was made with the remaining animals. he results are given in Table I.

TABLE I. — *Coefficients of Digestibility for Steers on different Planes of Nutrition.*

	Super Maintenance	Maintenance	Sub Maintenance
rotein	69.614	66.644	61.574
at.	83.781	84.042	81.043
ude fibres	43.296	29.417	30.048
l-free extract	85.478	82.485	79.699
otal nutrients	77.521	73.374	70.559

The figures show that the condition of the animal has a great influence pon its digestive capacity; a very meagre ration diminishes the coefficient f digestibility.

When a fat yearling steer is kept at body weight maintenance for one ear, his maintenance cost in nutrients per thousand pounds of live weight ; only slightly less during the first 6 monthly period than the second. During the first period the impetus to grow causes the addition of flesh and one. Fat must be consumed to maintain constant weight, thus sup- lementing the ration. During the second period, the impetus to grow s less, there is more active tissue to maintain and less available fat; ence the increased demand for food to maintain body weight.

During the first 188 days of the experiment, Steer No. 595 consumed 1 nutrients 8.06 lb. per day per thousand pounds, during the second period 20 lb.

As regards the 2 steers fed the submaintenance ration, during the first 88 days, one pound loss in weight effected a saving of 1.9 lb. of nu- trients for No. 591 and of 2.8 lbs. for No. 592. During the second pe- od (139 days), the loss of 1 lb. in weight effected a saving of 4.5 lb. of rganic nutrients. For the total period of 329 days, 3.7 lb. of organic utrients were saved by each pound of weight lost.

In the case of the 2 steers given the supermaintenance ration, ring the first 188 days, per 1 lb. gain in live-weight required (in addition he maintenance ratio), an extra consumption of 2.6 lb. of organic utrients by steer No. 593, and of 3.6 pounds by steer No. 599. For the

second period, the cost was 2.0 lb. and the average for the 362 days 3.0 lb. In the growing animal the cost of gain above the calculated maintenance ration appears to decrease during the second year of the animal's life.

Every month, 32 measurements were taken of each animal, in order to follow the changes in the skeleton. In this way the exact contour at the heart, paunch and flank girths was obtained. A chain of aluminium links, each one adjustable by means of a set screw, was used for measuring. It was found that the growth in height and length was not affected by the insufficiency of the ration. Later, the sub-maintenance animal stopped growing.

As the sub-maintenance animals lose weight, there is loss in amount of blood, but when the loss of weight is very great, the loss of blood is not proportionate to the loss of weight. With the maintenance and super-maintenance animals the ratio of hide to animal increased; with the sub-maintenance steers the hide apparently lost weight as did also the heart, liver, spleen and pancreas.

The authors give in their tables accurate data showing: the food consumed during each 10 days' period, the chemical composition of the food; the live-weight for each ten-days period; the body measurement (taken every month); the weight and composition of each organ and of the different parts of the body when the animal was slaughtered.

A summary of some of the most important data for the solution of the problems the authors had in mind are given in Table II.

TABLE II. — *Changes in the Chemical Composition of Steers over One Year of Age on Different Planes of Nutrition.*

No. of animal	Average daily change in live-weight	Duration of feeding period	Whole animal			Adipose texture		Lean Flesh		Skeleton		
			Moisture	Fat	Protein	Moisture	Fat	Moisture	Fat	Moisture	Fat	Ash
	gm.	Days	kg.	kg.	kg.	kg.	kg.	kg.	kg.	kg.	kg.	kg.
592	- 270	327	-26.4	-44.3	-10.9	- 5.1	-27.9	-27.3	- 8.1	+10.3	- 4.9	+0
591	- 200	186	-16.4	-25.1	- 3.9	- 1.0	-19.2	-12.8	- 5.6	+ 1.7	+ 1.6	+0
595	- 9	362	+10.3	+20.5	+ 1.3	+ 0.5	+17.6	+ 7.5	+ 3.5	+ 1.6	+ 1.6	+2
597	+ 32	188	+ 1.6	+ 1.3	+ 0.1	+ 2.7	+ 2.1	+ 5.6	+ 2.2	+ 0.2	+ 2.9	+0
593	+ 240	188	+13.5	+10.5	+ 3.1	+ 1.9	+ 6.8	+ 6.9	+ 0.5	+ 1.4	+ 2.2	+1

The authors draw from these data the following conclusion: when large amounts of fat are used by the animal as a source of energy to supplement a limited food supply, some of this fat is replaced by water.

The skeleton continues growing even under feed restrictions; its growth consists in an increase in protein and fat, as well as in mineral constituent.

When young beef animals in good condition are put on a ration insufficient to provide for normal growth, there is a very persistent tendency to grow in spite of feed restrictions. Much of the surplus fat will be used for

energy, and growth of both lean flesh and skeleton will continue. Later with continued food restrictions the animals will draw on both the residual fat supply of the soft parts and also on the protein of these parts to maintain existence and promote a normal growth of the skeleton which even includes the storing of fat in the latter. As the fat supply of the soft parts becomes more seriously depleted and much of the protein of the soft parts is used to preserve existence, the animal is able to make use of the fat supply of the skeleton until it is almost entirely exhausted.

II. — COMPOSITION OF THE BEEF ANIMAL AND ENERGY COST OF FATTENING. — The objects of this investigation are to determine: 1) the chemical composition of the gain made by steers in the process of being fattened; 2) the changes that take place in the form of the animal when it passes from the maintenance ration to the fattening ration; 3) the moment when the steer is just fat enough for all rational demands of the consumer, and how far this condition differs from that required by the market.

The principle results bearing on the first question have already been given by MOULTON in a preceding paper (1), in the work analysed, in addition to the data concerning the 3 steers (Nos. 18, 124, and 48), (which are chiefly used for the solution of the first question) are included those referring to 4 other steers of the maintenance group. Tables are given showing the amount of nutrients consumed by steers Nos. 121 and 48 and two others during the full period which succeeded the maintenance period; the weight of the carcasses and offal of each of the 7 animals the chemical composition of the organs and of the different cuts of steers No. 18, 121, 48 and of 1 of 4 other steers.

In order to study the changes in the form of the animals, a number of measurements were taken at short intervals, the exact contour of the animal being taken at heart, paunch and flank either by a chain of aluminium links adjustable at each joint by means of set-screws or else by a hinged wheel with adjustable blunt prongs. The latter apparatus was devised by F. G. KING and J. M. EYVARD.

From the total results obtained it may be gathered that when steer No. 121 passed from the thin condition of steer No. 18 to the average fat condition at which it was slaughtered, the lean flesh of the carcass increased 54 % and the soluble fat 284 %, while the whole carcass increased 76 %. The production of this amount of fat was in no sense waste, for it would all have been eaten by persons appreciating good meat. On the other hand the fat, lean flesh and carcass gains of No. 48 (the highly fattened animal), over the steer brought to the average fat condition were respectively 122 %, 20 % and 47 %. The fat in the highly fattened animal was too plentiful for the tastes of normal persons and therefore the energy employed in producing it was wasted.

III. — COMPOSITION OF CATTLE AT BIRTH (2). — For these researches

(1) See R. April 1918, No. 441. (Ed.)

(2) The *Research Bulletin* No. 35 of the University of Missouri Agricultural Station deals with the Birth Weight of Calves. This work has been summarised from another source in R. July 1919, No. 944. (Ed.)

7 aborted fetus or still-born Jersey calves and 13 Hereford calves slaughtered soon after birth were used.

The mothers were fed during gestation a grain ration of 6 parts of maize + 3 parts of bran + 1 part of linseed with roughage consisting of 3 parts of lucerne hay and 2 parts oat-straw. The cows and their calves were divided into 3 groups according to their rations of concentrates viz., high (which caused the cows to become fat during gestation); average (which kept them in good condition without fattening); low (this kept the cows in the condition of cattle on a southwest range under arid conditions. All the animals received as much roughage as they could eat.

The authors obtained the following data which they arranged in Tables: — weight of blood; of the hair and hide; of the meat (fat and lean); of the skeleton; of the most important internal organs; of the excreta and of the kidney fat; the chemical composition of the blood, liver, nervous system, organs taken together, the hair and hide, skeleton, meat, marrow, kidney fat, contents of intestine, entire animal. The averages of the analyses of the whole animal, the flesh (fat and lean), and of the skeleton are summarised in Table III.

TABLE III. — *Percentage Composition of New-born Hereford Calves and Still-born Jersey Calves.*

Race and feeding of the pregnant cows	Entire Calf				Meat				Skeleton			
	Water	Fat	Nitrogen	Ash	Water	Fat	Nitrogen	Ash	Water	Fat	Nitrogen	Ash
<i>Hereford:</i>												
Abundant . . .	72.4	4.15	3.00	4.15	0.805	76.3	4.41	2.79	0.984	64.3	3.97	2.88
Average . . .	72.5	3.57	2.97	4.51	0.809	76.5	4.07	2.77	0.988	65.0	3.36	2.85
Insufficient . . .	73.6	3.24	2.81	4.91	0.915	78.2	3.62	2.57	0.993	65.4	3.03	2.78
General average . . .	72.8	3.65	2.93	4.52	0.841	77.0	4.01	2.71	0.989	64.9	3.45	2.82
<i>Jersey</i>	73.4	3.82	2.88	4.15	0.681	77.4	3.12	3.19	0.974	63.0	2.18	3.21

The weight of the stomachs and intestines, and consequently of the internal organs as a whole are a higher percentage of the live-weight of the animal in Jersey calves than in Hereford calves. The weight of the hair and hide and possibly of the skeleton of the Hereford calves is higher in proportion to the live-weight than in the case of the Jersey calves. There is no apparent difference in chemical composition due to breed.

As regards the effect of the feeding of the cow during the gestation period (Herefords), it was found that the live weight of calves at birth from the high and medium planes of nutrition were practically the same, whereas that of calves whose dams were insufficiently fed was appreciably lower.

As regards the separated parts of the animal, the proportion of flesh

decreases and the proportion of skeleton and internal organs increases as we pass from the high plane of nutrition to the low plane.

Taking the average composition of the calves the proportion of fat and nitrogen decreases and that of moisture, ash and phosphorus increases as we pass from the high to the low plane of nutrition. Most of the fat of the new-born calf is found within the internal organs; the flesh and skeleton also contain fat but in small proportions. The sum of the percentages of moisture and fat, and consequently the percentage of moisture-free substance tends to a constant value, regardless of the plane of feeding of the dam.

IV. — THE NORMAL GROWTH OF DAIRY CATTLE. — In a preceding treatise (1) the factors influencing the rate of growth and the size of dairy heifers was studied. In the present Research Bulletin a more detailed study is made for determining the processes of normal growth and how it is attained.

The authors in order to arrive at a decision plotted the growth curve from birth to maturity (as represented by weight and height at withers), for cows of the Jersey, Holstein, Ayrshire and the dairy type of Shorthorn. They also collected data showing the average height at withers and weight of mature Jersey Holstein and Ayrshire cows.

Curves of this character are useful in research work as a basis of comparison for the growth of experimental animals. The figures of normal growth may be of considerable assistance to breeders of dairy cattle, giving them a means of determining whether their methods of feeding growing animals are such as to allow growth to continue at a normal rate, and to judge if an individual animal is of normal size for its age.

Table IV and V give some of the most important data.

TABLE IV. — *Average Weight of Jersey, Holstein and Ayrshire Cows from 1st to 5th Calving.*

	Holsteins		Jerseys		Ayrshires	
	Age	Weight	Age	Weight	Age	Weight
	Months	lb.	Months	lb.	Months	lb.
At 1st calving	30	965	29	764	28	868
At 2 months after first calving	36	962	35	779	34	840
At 2nd calving	43	1040	42	827	37	874
At 3 months after second calving	49	1071	48	854	43	892
At 3rd calving	57	1143	55	872	55	960
At 4 months after third calving	63	1136	—	—	61	952
At 4th calving	71	1219	68	887	74	1022
At 5 months after fourth calving	77	1200	—	—	80	980
At 5th calving	82	1247	80	919	92	1045
At 6 months after fifth calving	—	—	—	—	98	1023

(1) Summarised in *R.* October-December 1919, No. 1188. (Ed.)

TABLE V. — *Average Height and Weight of Mature Dairy Cows.*

Breeds	Height at Withers cm.	Weight pounds
Jersey American type	123.7	902
" All types	121.6	—
Holsteins	134.8	1245
Ayrshires	123.6	997

V. — STUDIES IN ANIMAL NUTRITION: CHANGES IN FORM AND WEIGHT ON DIFFERENT PLANES OF NUTRITION. — About 60 Hereford-Shorthorn beef steers were fed from a few weeks of age on milk, lucerne hay, and a grain ration of maize chop + whole oats + linseed meal in the ratio of 6:3:1. The ratio of grain to hay was: 2:1. The animals were weaned at ages varying from 2 to 7 months.

Three planes of nutrition were used 1) Full feed from birth; 2) Feed to produce maximum growth without appreciable fattening; 3) Feed for scanty and retarded growth. The length of the feeding period varied from a few weeks to 4 years.

The average daily increase in live-weight for the 4 years was 1.30 lb. for Group I 0.80 lb. for Group II and 0.65 lb. for Group III. The cost per lb. of gain was 12.24 lb. of dry matter for Group I, 11.91 lb. for Group II, and 11.03 lb. for Group III.

The growth of the Group I animals, as shown by height, width and length measurements, is considered as representing normal growth for this type of cattle. Growth is more rapid at the earlier ages and becomes much slower when the animal is older.

At 4 years the normal beef steer should be 140 to 150 cm. in height at the withers and hips, about 65 cm. wide at the hips and 187 cm. long from shoulder to rear of ischium. The heart girth should be about 250 cm.

The scantily fed cattle grew less rapidly in all respects. But when 4 years old they were of the same height as the full fed group. The age at weaning or at which they were put on poorer rations seems to have had no effect upon the ultimate height. Even a long maintenance period during the first year made no difference to their height.

The poorer rations brought about a material decrease in length, width and circumference of body, and in body weight. The animal kept at body weight maintenance for the greater part of a year failed to catch up in these respects even after 3 years.

The different rations fed seem to have no effect upon the breaking strength of the bones other than such as was due to increased weight. For all 3 groups the breaking strength was a function of the live weight. The formula is approximately $L = 16.5 W^{.68}$, where L is the breaking load and W is the live-weight.

For very fat Group I cattle this gives results much higher than the observed breaking load.

F. D.

281 - **Hay Made from Liberally Fertilised Young Grass, a Farm-Grown Concentrated Food.** — I. NEUBAUER, Die Gewinnung von jungem Grass nach starker Stickstoffdüngung, ein Mittel zur Erzeugung von Kraftfutter in der eigenen Wirtschaft, in *Biedermann's Zentralblatt*, Year 4, Part 7, pp. 272-275. Leipzig, July 1921. — II. HÜTTINGER, Welche Nutzenwendungen muss der praktische Tierzüchter aus den Kriegserfahrungen für die Züchtung seiner Nutztiere ziehen? in *Deutsche Landwirtschaftliche Presse*, Year 49, No. 1, pp. 1-2. Berlin, January 4, 1922.

I and II. — NEUBAUER and HÜTTINGER point out the economic importance of a farm being self-supporting, especially as regard stock-feeds including concentrates.

Hay made from young grass possesses the two qualities necessary for concentrated feeds, a low fibre content and a high percentage of protein (20 to 23 per cent of dry matter as against the 12 % found in ordinary hay). As a concentrated food, young grass (the dry matter content being equal) has almost as high a value as brewers' grains, and it is also a very wholesome diet.

NEUBAUER carried out his experiments in a good meadow on the lower Rhine. One part of the ground was mown 3 times in the year, and another every 2-4 weeks (at longer intervals in periods of drought). A portion of the latter plot was left unfertilised, while the other was liberally dressed with sulphate of ammonia each time the grass was cut, from 12 to 16 quintals of the fertiliser being applied per annum. The results obtained are given in the following Table.

Effect of a Nitrogenous Fertiliser on the Production of a Meadow.

Years	3 cuttings per annum without fertiliser		From 6 to 8 cuttings per annum			
			Unfertilised		Fertilised	
	Dry matter per hectare kg.	Protein per hectare kg.	Dry matter per hectare kg.	Protein per hectare kg.	Dry matter per hectare kg.	Protein per hectare kg.
1916	10 364	1 483	6 575	1 325	10 358	2 265
1917	6 277	884	4 603	862	7 934	1 706
1918	6 807	947	4 299	912	8 169	1 954
1919	—	—	4 108	685	7 465	1 375

The fertiliser increase the grass-crop by about $\frac{1}{3}$; the dry matter content, whether expressed as weight or as starch value, was increased in about the proportion of 100 to 180; the protein content was nearly doubled.

F. D.

[280-281]

282 - **Connection between Degree of Milling and the Composition and Food Value of Bran.** — HONCAMP, F., and NOLTE O., in *Landwirtschaftliche Versuchs-Stationen*, Vol. XCVI, pp. 121-142. Berlin. Summarised in *Biedermann's Zentralblatt*, Year I., Part 7, pp. 266-268. Leipzig, 1921.

Table I gives the results of the analyses of rye and wheat brans obtained with various degrees of milling. The authors fed these brans to lambs and determined the coefficient of digestibility for each constituent; the percentages of digestible nutrient substances given in Table II were thus obtained.

TABLE I. — *Percentage Composition of Brans
Obtained by different Degrees of Milling.*

	Organic matter	Crude Protein	Pure Protein	h-free extracts	Crude fats	Crude fibre	Ash
<i>Wheat bran</i>							
Milling 75 %	94.97	17.02	15.56	65.62	4.61	7.72	5.03
" 83 "	93.89	17.32	15.33	62.18	5.08	9.31	6.11
" 94 "	95.28	15.28	13.21	62.62	4.28	13.10	4.72
<i>Rye bran</i>							
Milling 65 %	96.41	15.51	13.35	74.14	3.30	3.46	3.59
" 84 "	96.07	16.37	14.80	70.50	3.87	4.33	4.93
" 94 "	92.52	19.04	17.08	57.87	4.99	10.62	7.48

TABLE II. — *Percentage of Digestible Nutrient Substances
Obtained by different Degrees of Milling.*

	Crude protein	Pure protein	N-free extracts	Crude fats	Crude fibre	Starch Value
<i>Wheat bran</i>						
Milling 75 %	14.36	12.9	52.82	4.05	2.13	51.2
" 83 "	14.19	12.2	46.95	4.29	3.73	48.1
" 94 "	11.02	8.9	30.12	3.45	4.89	40.0
<i>Rye bran</i>						
Milling 65 %	12.08	9.9	64.28	2.53	2.06	57.4
" 84 "	12.77	10.2	60.42	3.01	1.78	54.9
" 94 "	14.85	12.8	26.74	3.97	5.89	33.4

These data prove that the degree of milling is a good measure of the food value of a bran, the finer the milling, the lower is the value of the bran.

F. D.

283 - **Colour Inheritance in Mammals and Domestic Birds** (1). — PORCHEFEL, A., in *Revue vétérinaire*, Vol. LXXII, No. 9, pp. 541-548; No. 11, pp. 680-690. Toulouse, Sept. and Nov. 1921.

The author shows in the first place that the germs of the elements constituting the various colours of the plumage, fur and coats of the dif-

(1) See *R.* Jan. 1920, No. 81; *R.* Aug. 1921, No. 832. (*Ed.*)

ferent breeds which have been evolved are to be found in the plumage, fur and coats of the primitive types from which these breeds are derived. He then investigated colour inheritance and gives a summary of several studies on this subject and finally describes his own experiments with rabbits.

MAMMALS. — As regards *cattle*, Marcel VACHER (1) reached the following conclusions:

- 1) Red bull and cow: $\frac{5}{6}$ of the progeny are red and less than 1 % are white.
- 2) If one of the parents is white and the other red, 90 % of the progeny are roan, 4 % red and 6 % white.
- 3) Two white parents nearly always produce white offspring.
- 4) One white parent and the other piebald-red or roan have red, white and roan calves in variable proportions.
- 5) Two roan parents produce offspring of all the various colours and shades of coat met with in the Durham breed, viz. red, roan and even white.

6) The first calf of a Charolais bull and a red Durham cow was a heifer with light-red coat; all the cows from this first cross were served by a white Charolais bull, and only 6 % of the progeny were white.

As regards *horses*, many data have been collected.

According to WILCKENS, 5743 matings of animals registered in the English Studbook (3016 of the animals being pure-bred, 1865 English half-bloods, and 861 pure-bred or half-blood Arabs) gave the following results:

English thorough-breds: *a*) parents of the same colour transmit their coat colour in the proportion of 85.6 %;

b) when the parents are of different colours: 43.7 % of the offspring inherit the coat colour of the sire; 50.8 % that of the dam; 5.5 % differ in colour from both sire and dam.

When the parents are of the same colour, a chestnut coat is the one most frequently transmitted 977.6 p. 1000.

If the parents are of different colours, bay appears in 50 to 60 % of the foals.

In similar cases, black is much more rarely transmitted: 10 % only of the foals being black.

The same proportions occur in half-blood English horses.

When pure-blood and half-blood Anglo-Arabs are of the same colour, they transmit their coats in 83.7 % of the cases.

Should the parents be of different colours, 31.3 % of the foals inherit the sire's coat, 50.6 % the dam's coat, and 12.1 % do not inherit the coat of either sire or dam.

White or light-grey parents transmit their coat colour in 90 % of the cases.

(1) M. VACHER, Transmission de la couleur chez les animaux de la ferme, *Bulletin de la Société Nationale d'Agriculture de France*, 1905. (Author's note)

If they are of different colours, white is dominant in 73 % of the cases. Bay is transmitted in 55.1 % of the cases, and black in 19 %.

CABRIFORCE (1) by examining the pedigrees of 197 horses at the annexe of the Saint-Julien remount Station obtained the following data.

The offspring of a stallion and brood-mare of similar coat colour usually inherit the coat of the parents (81 %). In such cases, chestnut is the colour that is most likely to be transmitted, occurring 95 times out of 100 whereas bay is only inherited 77 times out of 100. When a stallion and mare of different coat colours are mated, the offspring nearly always (90 times out of 100), inherit the colour of one or other parent.

The dam seems to exercise a preponderant influence upon the coat-colour of the offspring; 58.5 times out of 100 the foals are the colour of the mare and only 41.5 times in 100 do they inherit the coat-colour of the sire.

A chestnut coat which is so surely transmitted, when both parents are chestnuts, also occurs frequently when one of the parents is a chestnut, or even when both are of another colour; 39 matings of a bay stallion with bay mares gave 9 chestnut foals, of which 3 were dark chestnut with mane, tail and legs darker than the coat. Grey coats are also transmitted in rather high proportions:

a) 22 matings of chestnut stallions with grey mares resulted in: 50 % grey foals; 36.3 % chestnuts; 9 % bays; 4.5 % blacks.

b) 6 matings of a grey sire and chestnut dam resulted in: 3 grey offspring and 3 chestnuts.

c) From 10 matings of a grey sire and grey dam were obtained: 40 % bay foals; 50 % grey; 10 % chestnut.

d) 11 matings of a grey sire and grey dam resulted in: 54.5 % grey foals; 36.3 % bays; 9.0 % chestnuts.

e) From 2 matings of grey parents 1 grey and 1 chestnut foal were obtained.

A black coat is transmitted with the greatest difficulty: 11 animals with black coats (6 stallions, 5 mares), on being mated with animals of a different colour, transmitted their coat once only.

a) A chestnut sire mated with a black mare produced one brown-bay foal;

b) Four other matings of bay sire with a black mare gave 3 bay foals and one chestnut;

c) Four matings of black sire with bay dam produced 1 black foal 1 chestnut and 2 bay, of which 1 was a dark brown-bay;

d) With a black sire and chestnut dam a brown-bay was obtained

e) With a black stallion and a grey mare, a dark-grey foal was obtained.

CABRIFORCE's statements as regards the influence of the dam'

(1) CABRIFORCE, Observations hippiques sur le contingent de 1899. Influence des reproducteurs sur la robe des produits, in *Recueil de mémoires et observations sur l'hygiène et la médecine vétérinaire militaire*. (Author's note)

coat-colour upon that of her offspring, the difficulty of transmitting a black coat and the facility with which chestnut and grey coats are inherited entirely corroborate the statements of WILCKENS.

DUPAS, quoted by FLORIOT (1), has also collected some data respecting the 300 horses at the Fontenay-le-Comte Remount Station which may be summarised as follows:

1) Inheritance frequency of coat-colour: a) bay, is transmitted 208 times out of 310 (66 %); b) chestnut is transmitted 87 times out of 181 (48 %); roan, is transmitted 5 times out of 11 (45 %); grey, 5 times out of 30 (17 %); black, 3 times out of 25 (12 %).

2) Sex influence: Stallions transmit their coat colour more frequently than mares: the transmission percentage being 48 for the former and 39 for the latter.

3) Transmission of coat-colour of parents: when sire and dam are of the same colour 85 % of the offspring inherit this colour: a chestnut coat is more easily transmitted (91 out of 100 times) than a bay (83 out of 100 times).

In *swine*, a white coat is most easily transmitted. As regards *rabbits*, Gustave LOIZEL (2) has drawn the following conclusions from the results of his experiments.

From a black buck-rabbit mated with a Russian doe, 9 black young were obtained.

A grey buck-rabbit mated with a Russian doe produced a litter of 5 grey and 3 black. These young rabbits, when mated together, produced 74 offspring, of which 58 had the characters of the grey rabbit and 16 those of the Russian rabbit.

As was to be expected in such close in-breeding, the young Russian rabbits of the last litters showed a tendency to lose the coloured spots characterising the breed, and for the same reason, large white patches appeared on the head and shoulders of the young grey rabbits of the same litters.

The mating of a white Angora buck-rabbit with a grey doe-rabbit resulted in 3 litters of 26 grey young with black eyes, which either inherited from the male brushes of long hair underneath their paws or else were entirely grey-Angoras.

An ordinary dark-grey buck-rabbit with white on the forehead, tip of the nose, the neck and tips of the fore-paws, when mated with a white Angora doe-rabbit produced in 3 litters, 9 young, all resembling the breed of the buck, and with white markings distributed as follows; one dark-grey rabbit had a white star on its forehead, another was dark-grey with white star on its forehead and white tips to its fore-feet, a third had the

(1) FLORIOT, L'hérédité chez le cheval, *Revue vétérinaire militaire*, Dec. 1913. (Author's note)

(2) G. LOIZEL, Recherches sur l'hérédité des caractères du pelage chez les lapins, *Comptes rendus de la Société de Biologie*, Feb. 3, 1906. (Author's note)

front half of its body and half its head white, the rest of its body being dark-grey.

Saint-Yves MÉNARD mated a white Russian buck-rabbit with a silver-grey doe-rabbit and obtained black offspring.

These black rabbits when mated produced black young for 3 or 4 generations, but in the 5th generation one white rabbit with black feet was found in the litter; this was a case of atavism.

The author's experiments made in collaboration with Prof. BOUCHER yielded the following results:

1) A black buck-rabbit on being mated with a white doe-rabbit produced: 2 black young; 1 dark silver-grey with white head.

2) Black buck-rabbit \times white doe-rabbit: 5 grey, 2 black.

3) A black rabbit resulting from experiment 1, on being mated with its dam (a white rabbit), produced: 3 black and 1 white. The proportion of pigmented individuals was larger than that of the white; in the last case the young were $\frac{3}{4}$ white rabbit blood and $\frac{1}{4}$ black rabbit; in experiment 2 there was a throwback to fawn-grey. This atavism is proved by several other series of experiments made by the author and has been confirmed by COLLIN (1) who says he frequently saw little red rabbits resembling their grandfather amongst the white individuals of each litter resulting from the several matings of white doe-rabbits with black buck-rabbits.

BIRDS. — From 1893 to 1903, Gustav LOIZEL (2) studied the inheritance of plumage colour in the carrier-pigeons of the military pigeonot at Vaugirard and came to the following conclusions:

1) If 2 pigeons of similar plumage are mated, 85 % of the young birds will have the same plumage as their parents.

2) If 2 pigeons of different plumage are mated, their progeny will vary, according to the mixtures, in the following proportions.

a) The mixture mottled blue gives: 62 % mottled birds; 37 % blue and 0.88 % with new plumage colours.

b) The mixture mottled red gives 42 % mottled birds; 46 % red 12 % with new plumage colours.

c) The blue-red mixture gives 13 % blue birds; 36 % red; 50 % with new plumage colours.

d) The white-blue mixture gives: 36 % blue birds; 40 % white 24 % of new plumage colours.

e) The white-mottled mixture gives: 33 % mottled; 44 % white 23 % with new plumage colours.

Certain colours of plumage are dominant over others, thus mottled is dominant over blue, red over blue, and white over blue and mottled.

The progeny of the same pair, generally remains the same every year at least for 4 consecutive years, when the parents and grandparents have the same plumage.

(1) G. COLLIN, *Traité de Physiologie*, 2nd edition, Vol. II, p. 791. (Author's note)

(2) LOIZEL, *Études sur l'hérédité de la coloration du plumage chez les pigeons voyageurs*. *Comptes rendus de la Société de Biologie*, Mar. 11, 1905. (Author's note)

The plumage colour of the young birds differs every year, however, when the parents have plumage of different colours.

If the genealogy of given pairs is followed for a certain number of generations, new colours are sometimes found to occur without the possibility of tracing them in the progenitors, even as far back as the 8th generation.

As a result of his numerous observations, the author concludes that "colour like every other character depends upon the parents' capacity of transmission, but some colours such as chestnut and grey in the case of horses are more easily transmitted".

When animals are the result of hybridisation or crosses between individuals of different breeds, there is no fixed rule as to colour-transmission and atavistic colours may occur to such an extent that colour-inheritance is in abeyance.

When however the breeds have long been subject to selection, and great care has been taken to insure uniform coat colour, as is the case with many breeds of cattle, the results are perfectly certain.

Coat colour resembles all other characters: the greater the number of the generations, the more likely it is that the organism will be imbued with the breed elements and the less the risk of any new characters arising, provided the environment remains the same." F. D.

284 - Mutations observed in the Skunk (*Mephitis pudita* and *M. hudsonica*) in the United States. — DETLEFSEN, J. A. (Laboratory of Genetics, Illinois Agricultural Experiment Station) and HOLBROOK, F. M. (Skunk Development Bureau, White Plains, N. Y.), in *Journal of Heredity*, Vol. XII, No. 6, pp. 243-254, figs. 9. Washington, 1921.

The authors give a short account of the fur trade in the United States which has increased during the last 10 years to such an extent that instead of exporting raw furs to Europe, America is even in a position to import skins to be dressed and made up in the country. One important source of the native supply is the skunk (*Mephitis* spp.) (1) which is bred in captivity or in a state of semi-domestication. The authors then describe their experiments in skunk breeding, the mutations obtained and their hereditary behaviour.

So far they have discovered 12 mutations in *M. pudita*, and 3 in *M. hudsonica*. Mutations are evidently fairly frequent in this genus, and have also been observed in skunks captured in various States. There are 5 distinct types of mutation: 1) self-black; 2) seal-brown white with stripes; 3) black-eyed white; 4) white with a small amount of pigment in eyes; 5) pure albino. The 3 different albinotic types represent simple changes in single genes and therefore each gives a monohybrid ratio when crossed with the wild form. There is no evidence that they may be multiple allelomorphs. The appearance of mutations is increased by in-breeding.

There was a great preponderance of females among the skunks born (37 out of 56). F. D.

(1) See R. August 1921, No. 846. (Ed.)

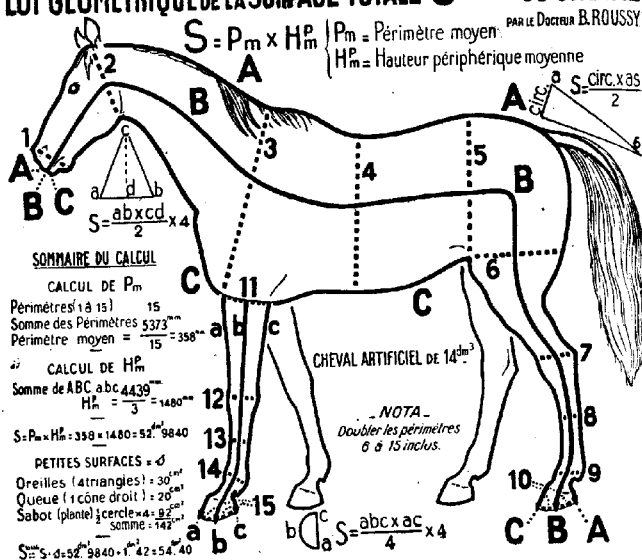
285 - Measurement of the Cutaneous Surface of the Horse. — ROUSSY, B., in *Comptes rendus de l'Académie des Sciences*, Vol. 174, No. 32, pp. 495-196, fig. 1. Paris, January 16, 1922.

From measuring the surface of the human body, the author discovered the "geometric law":

$$S = H^m \times P^m$$

where S represents the body surface, H^m the mean peripheral height and P^m the mean perimeter.

LOI GÉOMÉTRIQUE DE LA SURFACE TOTALE "S^{totale}" DU CHEVAL



Although convinced that this law is general, that is to say applicable to all measurable bodies, he wished to test it also upon quadrupeds beginning with the horse.

His first experiments were made on a small artificial horse and the results tested by covering the living animal with an artificial skin, which was afterwards removed, the pieces being laid out on a flat surface and their plane area determined; sometimes they were photographed.

In this way, he obtained a total measured surface of 54.37 dm², as against 54.40 dm² calculated according to the geometric law. The results thus practically agree, the difference being only 3 cm².

The examination of the appended figure will explain the processes by which the "geometric law" was evolved.

DETERMINATION OF THE MEAN PERIMETER P^m . — With a flexible accurate measuring-tape properly applied measure the perimeters alternately of the flattest and the most rounded contours of the head, neck, trunk, one hind-leg, and one fore-leg, as is shown by the dotted lines. In this manner, are obtained 15 perimeters numbered 1-15.

The measurements 10 and 15 are those of the lower border of the left side of both hoofs.

In order to obtain the measurements for the two other limbs, double the perimeters 6 to 15 inclusive. The sum of the 15 perimeters, 5373 mm. divided by their number (15) will give the mean perimeter P^m which is 358 mm.

DETERMINATION OF THE MEAN PERIPHERAL HEIGHT H^m . — Measure following all the curves of the skin, the chief out lines $A C$ and the line B drawn along the middle of the lateral surface of the animal, and then measure the three small lines $a b c$ on the left fore-leg.

The sum of these 6 lines (4439 mm. in the given case), on being divided by 3 (the common divisor of the two series of lines), gives the mean peripheral height H^m which is 1480 mm.

The surface S of the horse is $P^m \times H^m = 358 \times 1480 = 52.89 \text{ dm}^2$.

This result being very satisfactory might be adopted. If however desired, the negligible sum, 1.42 Sq. dm.(s) of the small surfaces of the ears, ail and soles of hoofs can be added (as was done above), and this gives the total surface (S^{total}) of 54.40 Sq. dm.

F. D.

86 - Characters of the Chilean Horse. — CORREA, A. V., L'ETHELIER, M., JUAN DE D. RODRIGUEZ, VIAL, D. G., in *El Agricultor, Revista dela Sociedad Nacional de Agricultura (Chile)*, Vol. VI (Vol. 52 of the *Boletin*), p. 201, No. 10. Santiago de Chile, October 1921.

Report of the Commission appointed by the Managing Board of the National Society of Agriculture and approved by the Society at its meeting of August 22, 1921.

GENERAL CHARACTERISTICS. — The Chilean horse belongs to a very muscular type; it is heavily-built, but agile, and its movements are swift.

The chest girth varies from 1.62 m. to 1.82 m. according to the animal's height which is from 1.35 m. to 1.50 m.

CHARACTERS OF THE BREED. — *colour* variegated; as a rule, the coat is of two distinct colours, or there is a little white on the forehead and legs.

Skin thick; little hair on fetlocks; mane and tail generally thick, hair wavy.

Head light, of medium length, forehead broad and flat, profile straight or slightly convex; eyes bright, slightly covered by the superciliary arch; ears small and mobile.

Neck of average length, wide at the base which is strongly joined to the scapula; slightly convex in the upper portion, full and nearly rectangular in the lower, slender at its junction with the head.

Withers usually too low, short and buried in masses of muscle. It

is necessary to improve the withers with a view to the saddle; they must be enlarged and made more prominent without the exaggeration seen in the pure-blood or hunter.

Shoulder very muscular but sometimes too short and too straight. Its slope and length must be increased in order to obtain the quickness of movement required in a saddle-horse.

Chest wide, muscular, shoulder-blades well separated.

Back very muscular, sometimes a little long and low where it joins the withers. It should always be strong and short (the length of the horse being obtained from a sufficient slope of the shoulders) with long withers, haunches and croup.

Haunches wide, muscular, strongly joined by a straight sometimes slightly convex line to the croup.

Croup long, full, slightly inclined. The tail is inserted rather low and is therefore generally pendent, or a little turned up at the lower part.

Trunk well-developed, ribs round, barrel cylindrical, and flanks short and full.

Fore-legs: fore-arm long straight, arm properly inclined, elbow free from chest, both very muscular; knee strong and wide; cannon-bone of average length relatively slender; seen from the side it should be wide sinews strong and standing well apart.

Hind quarters: haunch very muscular; the croup must be long, the leg wide, muscular internally and externally, hock dry and strong, sometimes a little narrow from the front view. The wide space between the legs when the horse is in motion is characteristic of the breed. It denotes strength and energy but must not be exaggerated, for thus the harmony of the animals' movements is unpaired.

Articulations: small, round and very dry.

Pasterns: short, strong, must have sufficient slope to be very elastic.

Hoof: relatively small, high; sole concave, frog little developed.

Character: Docile and a good worker.

287 - **The Donkey of Catalonia, Spain.** — ROSELL Y VILA, M. (Profesor de Zootecnia de Escuela Superior de Agricultura, Madrid), in *El Cultivador moderno*, vol. VII, No. 1, pp. 3 figs. 3. Barcelona, January 1922.

The Catalanian donkey is a native breed, as can be seen from prehistoric drawings and the neolithic remains.

The chief characters peculiar to the breed are described exhaustively by the author. They are as follows: head with rectilinear outline in adult animals, with double frontal convexity in young individuals, brachycephalous in type 0.56 m. to 0.68 m. in length; ears straight and long (0.38 m. to 0.42 m. in length); height 1.35 m.-1.65 m.; neck slender; shoulder not very sloping; withers little raised and distinct; dorsal fin straight and long; chest a little narrow but with spacious thoracic cavity; chest walls moderately rounded; croup short with double slope; sacrum very prominent; legs slender and strong. The coat of the adult donkey varies between chestnut and nearly black; the axilla, the flanks

portion of the thigh, lower part of chest and of the belly are all silvery white. The muzzle is white as far as the lower third of the nostrils and there is a white circle round the eye. Their harmonious shape, expressive faces and lively temperament give these donkeys a very handsome, high-bred appearance.

The measurements of a good specimen two years of age are as follows : height at withers 1.50 m. ; height at middle of back 1.46 m. ; length of back 1.45 m. ; girth of chest 1.60 m. ; circumference of tibia 22 cm. ; weight about 350 kg. The female donkeys give an extraordinary amount of milk, the lactation period is long and may even last 18 months ; from 4.5 to 5 litres of milk are given daily for a year, the amount decreasing to 2.5 litres at 18 months.

The jack-asses are chiefly used for the breeding of mules and must not be exported after they are 2 years old. Formerly they were exported practically to all parts of the world either for mule-breeding or to improve native races of donkeys in other countries. The price of a good breeding-animal is from 4 000 to 8 000 *pesetas*.

The Catalonian donkeys are of two types, the one inclining to height and the other to width ; the first are found in Comarca de Urgel and the second in Vich and Olot. The broad animals are preferred by the Italian and French importers and the tall by the English (for India, the African colonies and Australia) and by the North Americans.

The " Mancomunidad de la Cataluña " (Association of all the political parties of Catalonia) (1) has started a stud-book for donkeys in which the only entries are of breeding-animals which have gained prizes at the shows held by the " Mancomunidad " or the progeny of the prize-winners.

F. D.

8 - **The Cattle Industry of Cuba.** — NEVILLE, H. O. in *The Cuban Review*, Vol. XIX, No. 9, pp. 13-16, figs. 18. New York. August 1921.

Cuba is admirably suited to cattle-rearing. The climate is temperate and the temperature varies little which allows of the animals to be left in open pasture all the year round. Care must however be taken during the summer rainy season to remove the cattle from the low wet lands to the adjoining higher country, otherwise foot-trouble may result from the animals being continually in the water. In the dry season of winter, when grass begins to get short and scarce, and water hard to obtain on the higher better-drained areas of the interior, the cattle have to be brought down to the moist pastures at lower levels. Good water is practically obtainable everywhere throughout the Island, especially in the centre of the Provinces of Camagüey and Oriente.

Guinea Grass (*Panicum maximum*) and Para Grass (*Panicum molle*), have been introduced into Cuba and grow luxuriantly, furnishing the best

(1) The " Dirección de los Servicios de ganadería de la Mancomunidad de Cataluña, calle Urgel, 87, Barcelona ", will furnish information on all subjects connected with Stock-keeping in Catalonia. (Ed.)

of pastures, especially for fattening purposes. The former plant prefers the higher lands, the latter does best on the lower. Excessively close grazing will, however, destroy them and their places are taken by the native grasses of Cuba, of which the principal, "espartillo", is an excellent forage plant highly prized for milk production.

The topography of Cuba is favourable to the combination of agriculture with cattle-raising. In the Province of Pinar del Rio, in the southern portion of the Province of Santa Clara, in the northern portion of Camagüey, and throughout a very large area of the Province of Oriente, slightly undulating areas of agricultural land are found bounded by rough broken country in many places still covered with virgin forest, but where the trees have been felled, the slopes are all covered with tall rank grass composed of *Panicum maximum* and *P. molle*.

At the end of the War of Independence, the cattle industry had practically disappeared, but very soon large quantities of stock were imported from Florida, Texas, Mexico, Central America, Panama and Venezuela, and the supply exceeded the demand; this continued for some years.

In 1915 however many stock-breeders began ploughing up their pastures and planting them with sugar-cane. This change though slow at first, gradually became more rapid and reached its climax in the spring and early summer of 1920. The necessary results were a decrease in cattle production and increased importation.

Thus while from 1907 to about 1919, only breeding stock were imported, some 20 000 head of cattle were introduced in the 2 following years, the animals coming chiefly from Venezuela, Colombia and Costa Rica; a few have recently been imported from the United States. The animals imported after the War of Independence constituted, with their offspring, what might be called the native breed of cattle. They still exist in countless herds and are of a non-descript heterogeneous type. They are, however, being improved by progressive breeders through the introduction of high class pedigree sires of the Polled Angus, Hereford, Durham and Zebu breeds.

Some cattle-raisers greatly prize the Polled Angus race, as it has proved able to adapt itself to the climatic conditions of Cuba-is resistant to ticks and diseases, and produces fine beef-cattle.

The Hereford is also favoured, but is regarded by some breeders as a lazy animal which does not make full use of the grazing-ground.

The Zebu is perhaps the greatest favourite; it is almost tick immune of good form and excellent as a beef animal.

As a result of the introduction of the Zebu and the Polled Angus, vast number of cattle have been improved, the animals being heavier and producing meat of better quality.

The large Cuban sugar crop is hauled from the field to the railway loading stations in carts drawn by oxen of which 3 to 5 yokes are required for each cart. Assuming the annual amount of cane transported to be 36 360 000 long tons, it takes about 8 million cartages to haul it, each cart-load being 4.5 tons. Thus a great number of cattle are needed for

the work and it would be advisable to raise special breeds for the purpose. Among the favourites adopted by the Cubans almost from their first introduction has been a strain from Porto Rico consisting of heavy animals, of excellent disposition, easily trained and taking readily to the work. Certain types of Colombian and Venezuelan cattle have been found to be well adapted for use in carts. Cattle with a certain amount of zebu blood are much faster than the other strains used, but their wildness and the consequent difficulty in handling them is a great drawback.

The law requires that all cattle imported into the Island from South and Central America, Mexico and Texas should be dipped (to free them from ticks) at the port of introduction. In nearly all the better ranches of the interior, dipping has been adopted as the best means of getting rid of tick, but it is not compulsory. The subdivision of pastures and the systematic transfer of cattle from one subdivision to another with a view to the complete eradication of ticks has not yet been adopted.

The raising of stock in connection with the sugar-mills has not been fully developed.

The estimated consumption of cattle in Cuba is about 1000 head per day. Modern up-to-date abattoirs are rare in the Island; there is one at Camagüey and other at Havana. An attempt has been made to instal refrigerating plants, but without success for the Cuban has a prejudice against refrigerated meat, and when meat has been kept on ice at the butcher's it has to be sold as second grade meat.

The acreage under sugar-cane will probably decrease, which will result in an increase in the land available for pasture and hence in the number of cattle raised. A tremendous drop has already taken place in the price of cattle. Yearlings which fetched at least 45 dollars per head in 1920, could be bought for 15 dollars in the second half of 1921.

F. D.

289 - **Improvement of Dairy Cattle by Milk Control in Denmark.** — FABER, A. (Agricultural Commissioner to the British Government), in *The Journal of the Ministry of Agriculture*, Vol. XXVIII, No. 7, pp. 598-607, figs. 4; No. 8, pp. 704-711, fig. 2. London October and November 1921.

The first Danish Milk Recording Society was instituted at Vejen, in 1895 under the name of "Vejen Kontrolforening". The aim of this society was to ascertain the quantity and quality of the milk yield of individual cows in order to be able to eliminate the animals that did not pay for their keep and to reserve the best cows for breeding purposes. When the Vejen Society had been working for a year, it was found that the best of the controlled cows produced a pound of butter at the cost of 6d and the poorest cow produced a pound of butter at the cost of 2s 8d.

By the Law of 1902 the Danish Government made a grant not exceeding £10 to each Milk Recording Society of at least 10 members with 200 cows, on condition that the Societies should help to form better strains of dairy cattle. This grant was renewed by the Law of 1912.

The results of the institution of Milk Control Societies were: an increase in the general average of milk production, the adoption of a more

liberal teeding for cows, a selection of breeding-animals based, not as before, on external conformation alone but also on an exact knowledge of the quantity and quality of the milk produced and on the ability of the cow to transmit her character as a milk producer to her progeny.

The good results obtained by these Societies are shown by the records of those of Funen. These were founded in 1899-1900, in which year they controlled 5467 cows, the number rising in 1915-1916 to 40 116. The average annual milk yields of all the cows (whether in milk or not) belonging to the Societies being for these two years, 6 822 lb. and 7 938 lb. respectively; the fat percentage being 3.36 and 3.55, and the butter yield 255 lb. and 323 lb. respectively.

The Danish dairy farmer breeds his own cattle; he adopts in-breeding or line-breeding, thereby forming families.

Family herd-books are a special feature of Danish cattle-breeding, their value depending to a great extent on the work of the milk-recording societies. These herd-books have proved that the greater the number of high yielding animals a cow can count among her ancestors, the more likely she is to transmit the quality of high yield to her offspring. The author reproduces two specimen pages of the Book of Record Sheets on which are entered not only the cows' performance but also details relating to her ancestry and progeny. The family herd-books are not drawn up by the Controller of the Milk Recording Societies, but by the Agricultural Advisers appointed by the Agricultural Societies or the Joint Committees of Breeding and Milk Recording Societies. The State pays part of the salaries of these advisers.

About 1880 official herdbooks were started which are to some extent based on the family herd-books. These official herdbooks give the description and pedigree of the animal, as well as the milk and butter production in the case of a cow, and the performance of its female progenitors in that of a bull.

In order to find herds which not only contained prominent animals but consisted of families from which a good supply of breeding stock could be obtained for the improvement of other herds, competitions were carried out for one year at a time; later, these competitions lasted two years. The first was held in Funen in 1894-1896 and the 7th in 1913-1915. Another series was begun in Sealand in 1897. The best herds were officially recognised as "Breeding Centres".

The results obtained at Funen were as follows: 1st *biennial competition*: 7 competing herds consisting of 530 cows: average annual milk production per head 697 gallons, fat percentage 3.44 — 4th *competition*: 18 herds 777 cows, 853 gallons of milk, at percentage 3.53 — 7th *competition*: 10 herds, 304 cows, 934 gallons of milk, fat percentage 3.83. These competitions between entire herds are a peculiarity of Danish cattle-breeding. The Government encouraged them by annual grants.

An important step forward was made when it was ascertained from the records of the Milk Recording Societies that the capacity of yielding

large quantities of milk with a high fat percentage can be transmitted through the bull to his progeny.

By the Laws on Breeding Domestic Animals (1887 and 1902) grants were made by the Government for prizes for bulls at District Agricultural Shows, under the conditions that the animals were to be kept for service in the country at least until May 1st in the following year and that bulls 5 years old or older should be judged through their offspring. This second proviso gave rise to "Offspring Shows" which are also a special Danish feature. By these means farmers have for a number of years been encouraged to preserve good bulls for service. While in 1887, only 371 bulls were presented at the District Shows, in 1908 more than 1200 were presented at the State Shows, and as many as 250 old bulls are entered at local shows every year.

The law of 1902 offered a further grant of £750 to cattle breeding societies "which by showing superior offspring have proved to be particularly capable of developing good strains of dairy cattle." In order to participate in this grant, the Breeding Societies must exhibit at the Offspring Shows their bulls and $\frac{1}{8}$ of the total number of their cows, and at least 2 bulls and 24 cows. One fourth of the cows must be between one and two years old and for $\frac{1}{4}$ at least, two years' milk records must be produced. Breeding Societies have an additional claim to the grant if they have formed or are about to form tribes or families of dairy cattle producing a high yield of butter. When the Law was amended in 1912, further encouragement was offered to cattle-breeding societies having many of their cows under the control of the milk-recording societies. A grant is offered for each bull belonging to a cattle-breeding society when the bull is at least 1 $\frac{1}{2}$ years old and has been awarded certain prizes at shows; the amount of the grant varies according to the proportion of the cows belonging to the breeding society that are being reliably controlled as to their yield of milk, butter production and consumption of fodder.

When the Milk Recording Societies had worked for a considerable number of years and had on their books some 15 000 herds including 250 000 cows or about $\frac{1}{3}$ of all the cows in the country, a large amount of information was available.

This statistical material was worked up by the Federations of Agricultural Societies. The investigations are now carried on to a large extent by the Officers of the Provincial Federations, the Government defraying part of the cost. These records are used to determine which of the registered bulls influence the milk yield of their progeny, so that it is higher than that of the dam of the bull. Butter production is taken into special account.

Both with the Red Danish Dairy Cattle and the Jutland Breed much of the progress during recent years is due to the influence of a few bulls having remarkably strong power of transmitting higher milk yielding capacity to their progeny.

The use of milk records in the breeding of cattle both by line-breeding and employing bulls selected as explained above, has now been carried

on long enough to show definite results; this is clearly seen by comparing the yield of the herds at two different periods.

Year	Yields of milk	Fat	Yields of butter
<i>Red Danish Breed.</i>			
1905 - 1906	8.941 lb.	3.58 %	356 lb.
1915 - 1916	10.041 "	4.11 "	4 602 "
1905 - 1906	9.427 "	3.40 "	356 "
1915 - 1916	11.282 "	4.30 "	546 "
<i>Jutland Breed.</i>			
1900 - 1901	5.315 lb.	3.09 %	183 lb.
1916 - 1917	8.175 "	3.87 "	354 "
1897 - 1898	5.922 "	3.01 "	196 "
1913 - 1914	8.538 "	3.84 "	367 "
<i>Shorthorns.</i>			
1901 - 1902	6.864 lb.	3.62 %	277 lb.
1911 - 1912	10.164 "	4.06 "	460 "

Averaging 18 herds of all 3 breeds during a period of about 14 years the milk yield has been increased 26 % and the butter production over 50 %. The improvement has been general throughout the country and is not confined to the stock of eminent breeders, but extends also to that of small farmers. In the opinion of MÖRKEBERG: "the capacity to yield much milk and the capacity to yield rich milk are two different characters, both hereditary, but inherited the one independently of the other." If this is correct, the problem is still easier for a country where a high milk yield is the main object, than for Denmark, where a large production of butter is required.

The rules for Cattle Shows vary a little in the different Provinces; the author quotes as instances some of the rules for the provincial Shows held by the Associated Agricultural Societies in Funen. F. D.

290 - **The Utilisation for Grazing-Grounds of the De-forested Lands of the South of the United States.** — FARLEY F. W., and GREENE, S. W. (Animal Husbandry Division, Bureau of Animal Industry, U. S. Department of Agriculture) in *United States Department of Agriculture, Bulletin No. 827*, 51 pp., figs. 13. Washington 1921.

The authors, give an account of the cattle-rearing conditions existing in the coastal plain of the South-East of the United States and the value as grazing grounds of the land formerly covered with pine-forests. They describe, the conditions of the climate and soil; system of land tenure; pastures; methods of feeding the cattle; building and shelters for stock; diseases and pests; water supply; the condition of the markets.

At the present time the area of this region (which includes the south-eastern portion of South Carolina, most of Florida, the southern part of Georgia, Alabama, and Mississippi, the central and northern part of Louisiana and parts of south-eastern Texas and of southern Arkansas, is estimated at 100 000 000 acres, and is being increased by about 10 000 000 acres annually as additional land is "cut over". The sandy soil is of sedimentary origin and is the natural habitat of the long-leaf yellow pine (*Pinus palustris*). Although the cattle industry has been growing rapidly since 1910, it has not developed to the full extent possible. The animals are of poor quality owing to various causes, but especially to the cattle tick which makes it impossible to keep pure-bred or grade animals in this district. Mature cows average about 400 or 500 lb. and steers of 3 to 5 years of age average from 600 to 750 lb.

The most important stock-breeding problem is the improvement of the pastures which can be effected by the distribution and protection of *Lepidolobos* (Japanese clover), and of *Axonopus compressus* (carpet-grass). The native pastures furnish good grazing from early spring until about July; later, the quality of the grass deteriorates and in the winter, forage has to be fed to the cattle. Amongst the winter feeds the author recommends (as bulky fodder), maize stalks, hay made from leguminosae, cotton seed meal and maize silage (as concentrates), velvet-beans (*Stylobium* sp.) in the pod.

The author gives the results of a feeding-experiment in which the Mississippi Experiment Station collaborated. This experiment has shown that the same increase of live-weight, at the same cost is obtained by feeding the cattle on maize silage or velvet-bean pods whether crushed or whole. The animals, however, eat the whole pods more readily.

F. D.

291 - The Value of Beet Molasses in the Ration for Fattening Steers. — GRAY, A. S. in *Facts About Sugar*, Vol. XIII, No. 6, pp. 112-113. New York, August 6, 1921.

An experiment has recently been carried out by the Iowa Experiment Station at Ames with a view to determining whether beet molasses or cane-molasses (both well-known to be excellent feeds for beef cattle), is the more efficient and economical.

Prof. EYVARD finds that when maize sells at 1.71 dollars per bushel, it is cheaper to feed molasses at 45 dollars per ton, but when maize is selling at 50 cents per bushel and 30 dollars per ton is paid for molasses (as in the United States, in 1921) molasses is too expensive.

The experiment was carried out with 5 lots of grade Hereford steers. Lot I which served as a control, received the standard maize-belt ration viz. (for the entire period), 21 lb. shelled maize + 10 lb. maize silage, 5 lb. mixed timothy and clover hay + 3 lb. linseed oil meal.

Lot II received in addition to the standard ration, 2 lb. cane molasses per head, per day but ate 2.5 lb. less maize, 2 lb. less silage, the same oil-meal and less hay than Lot I.

Lot III was fed the same ration as Lot I with the addition of 5 lb. cane

molasses. The animals received up to 8 lb. daily for a while, which was all they could consume, but the extra feed did them no particular good.

Lot IV got the regular ration with 2 lb. beet molasses added. Lot V was fed the standard ration plus 5 lb. beet molasses.

The experiment lasted 120 days. The initial weight of the steers was 1 000 lb. each and the range of weights at the end was 1356 to 1430 lb., the variation being due to the different rations.

The daily increase of live weight was 48 oz. per head and per day on the average for all the groups. All groups with the exception of the Vth showed less increase in weight than Lot I, which showed an increase of 49 oz. per head and per day, the increase for Lot V being just over 48 oz. Both gave a return of 61 % when killed, all the others proving less profitable.

Lot II, III and IV would in any case have showed inferior results to Lot I even if the molasses consumed had cost nothing. On the other hand Lot V, which consumed the maximum amount of beet molasses, made a better use of its food and shewed an increase in weight practically equal to that of Lot I, was sold for practically the same price per lb. of live-weight and as it consumed the least expensive ration really proved the most satisfactory.

F. D.

292 - *The Sterilisation of Cows.* - I. GAVARD, G., in *Recueil de Médecine vétérinaire*, Vol. XCVII, Nos. 22-24, pp. 429-433. Toulouse, November 30-December 30, 1921. - I. BOUCHET, *Ibidem*, pp. 441-443.

I. After having tried for the sterilisation of cows the crushers of CHASSAIGNAC, FLOCARD and KREBS, BERTSCHY and DEGIVE's elastic ligatures, metallic ligatures, American forceps (all with unsatisfactory results), and also the ovariectomies of BERTSCHY and FAVRE which gave better results, although all danger of haemorrhage was not eliminated, the author finally decided to adopt the HESS ovariectome (invented in 1912), which gave him complete satisfaction. Since 1913, he has used this instrument in the Canton of Geneva and the Departments of Haute Savoie and Ain, operating upon 700 to 800 cows annually without a single accident that could be attributed to the treatment.

The HESS ovariectome consists of a double metallic rod and of a movable rod sliding in the fixed part and provided at the end with a screw which is worked by a nut. The movable rod has at the end an oval ring bearing on either side a narrow process fitting into the corresponding slot-hole. A very ingenious type of guillotine is fixed to the apparatus and assists in cutting the neck between the ovary and the extreme limit of the crushed portions. A movable handle, that can be affixed to the rod according to the wish of the operator, gives a firm point of support which allows of great pressure being applied.

The advantage of this angiotribe is that it caused a double crushing and knife is independent and movable, working with a sliding motion, so as to cut outside the laminated margin.

II. - BOUCHET has presented to the Central Society of Veterinary Medicine a ovariectome invented by himself.

This instrument consists of two parts acting as a crusher, that is to say, of a groove in which slides a wormed rod which is drawn down by a nut. At the opposite end, the groove and the screw are both provided with a very wide expansion containing an aperture 50 mm. by 60 mm. through which an ovary can pass. These two apertures correspond when the instrument is open. On moving the nut, the screw is drawn down and with it the aperture at the end of it. This opening then slides in front of the aperture at the end of the groove which remains fixed. This displacement constricts the neck of the ovary which is soon compressed and crushed between the sides of the apertures. These are provided with a projecting ledge furnished with small oblique and opposite incisions forming the two jaws between which the neck is ground. At the extreme limit of their course, the ovary is detached by a blade that only comes into operation after the compressed bundle is crushed.

F. D.

293 - **Possibility of Increasing the Milk Yield of the Charolais Breed.** — CHARON, AD. J. in *Journal d'Agriculture pratique*, Vol. I, No. 4, pp. 80-81, Paris, January 28, 1922.

On January 15 and 16, 1922, a Cattle Show was held at Charolles by the Breeders' Society and the Agricultural Society of the Department of Saône-et-Loire; 150 Charolais cattle, most of them magnificent specimens, were exhibited and proved the remarkable results obtained by selection. The extreme breadth of back, great development of the rump and the width of the hind quarters, all characteristics of the Charolais breed, were accentuated more each year.

Further, there is every possibility of increasing the hitherto low milk-yield of the cows. In fact, nearly all the cows exhibited by one breeder, which were as fine as any of those exhibited, had an extra teat, which is a sign that a milch-cow line could be evolved within the breed.

F. D.

294 - **Sheep-Rearing on Temporary Pastures in the United States.** — MARSHALL, F. R. and PORRIS, C. G., in *United States Department of Agriculture, Farmers' Bulletin* 1181, 18 pp., figs. 7. Washington, 1921.

The authors show the economic advantage of temporary pasture in the case of sheep-farms, and describe the systems adopted at the Experimental Farm, at Beltsville (Maryland), where the sheep are turned out at the beginning of April to graze on a field of barley, or rye, and in the summer and autumn are grazed on forage consisting respectively of: lucerne, oats and peas; colza, soy-beans and maize; "velvet beans" (*Stizolobium* sp.). These forage crops, which last one year, cover 12 hectares: 20 acres supply on an average 250 grazing-days for 1 sheep. The fields are divided up into plots in each of which the sheep are kept for 14 consecutive days, but not longer. It is advisable for these plots to be rather narrow, so that they can easily be subdivided by small, movable hurdles.

Such a temporary ley, not only supplies food for a greater number of sheep per acre than permanent pasture on equally fertile soil, but it allows the grazing ground to be more frequently changed thus dimin-

ishing the danger of infestation by intestinal worms and other internal parasites.

Further, the temporary pasture as compared with the permanent pasture induces a more abundant milk supply which is more uniformly distributed during the lactation period.

It is wise to cultivate wheat if possible rather than rye, as it makes a better spring fodder. Oats and peas mixed are excellent, although on rich soil, colza makes the cheapest pasturage for sheep. Where the soil is not deep, it should be sown with soy-beans. The sheep may be left out on grass from July until the first frosts.

Lucerne and melilot make excellent fodders for sheep; especially if precautions are taken to avoid flatulence.

F. D.

295 — Experiments in Rearing Sheep and Goats in the United States. — I. JONES, J. M., BREWER, R. A. and DICKSON, R. E., Grain Sorghums Versus Corn for Fattening Lambs, in *Texas Agricultural Experiment Station Bulletin* No. 269, p. 13. College Station, 1920. — II. MAGEE, W. T. and DARLOW, A. E., Sheep-Feeding Investigations, in *Oklahoma Agricultural and Mechanical College, Agricultural Experiment Station Bulletin* No. 133. Stillwater, Okla., 1920. — III. MILLER, E. C. (Sheep Extension Specialist, University of Kentucky), Facts that Sheepmen Desire to Know, in *The Breeder's Gazette*, Vol. LXI, No. 5-2095, pp. 139-140. Chicago, February 2, 1922.

I. GRAIN SORGHUMS VERSUS MAIZE FOR FATTENING LAMBS. — Feeding experiments carried out for 90 days and begun on November 26, 1919. Six lots of 20 lambs of the average weight of 59.42 lb. were used. In all 6 lots, each lamb received an average ration of 1.08 lb. grain, 0.14 lb. cottonseed meal and 1.89 lb. lucerne hay. The grain fed each lot was respectively: 1) ground milo heads; 2) ground threshed feterita; 3) ground maize; 4) ground threshed milo; 5) ground feterita heads; 6) ground threshed kafir. The average daily increase in weight of the 6 groups per head and per day was respectively 0.362 — 0.36 — 0.393 — 0.394 — 0.339 — 0.372 lb. In order to obtain 100 lb. gain the 6 groups consumed respectively: 337.01 — 338.66 — 310.43 — 309.89 — 359.99 — 327.75 lb. of grain + cotton-seed meal 523.02 — 525.60 — 481.76 — 480.94 — 558.68 and 508.65 lb. of hay.

The authors give the analysis of the foods used and their productive value calculated according to FRAPS' system (1).

(1) See: G. S. FRAPS, The Production Coefficients of Feeds in *Texas Agricultural Experiment Station Bulletin* 185, 1916. The value of a feed is measured by: the volume which satisfies the appetite of the animal, the content of digestible protein furnishing the material for rebuilding or repairing the muscular tissues, etc., and by its "productive value" which is its value as a source of energy capable of being transformed into internal or external work, heat, fat, etc. This Bulletin describes the method suggested by FRAPS for calculating the productive values of feeds from their chemical composition.

The productive value of a food is defined as follows: the amount of fat which this food would produce in the case of an animal that is being fattened, if it were fed in addition to a basal ration sufficing for the requirements of the organism. The author prefers calculating the productive value in terms of fat, because fat most nearly represents the substance actually measured in the experiments and by adopting this method, there is no need to have

The productive values of the rations used were respectively 16.3 — 10.6 — 20.3 — 18.5 — 16.0 — 14.4.

Lot IV made a slightly larger, but much more economical gain than Lot III, the net profit being 2.73 dollars per head in Lot IV while it was only 1.70 in Lot III.

Lot I made a slightly larger and much more economical gain though Lot V approached very closely.

Ground milo heads (Lot I) give a slightly lower increase in live-weight than ground threshed milo, but were more economical.

This test proved conclusively that for fattening lambs maize shipped into Texas cannot successfully compete with the grain sorghums of the semi-arid sections of Texas which are so well adapted to the production of these non-saccharine sorghums.

II. COMPARATIVE RATIONS FOR FATTENING CASTRATED LAMBS. — The feeding experiment began on November 20 and lasted 96 days; the experiment with Lot II was suspended after 70 days. No loss was occasioned by the liberal ration of cotton seed cake. Lot I which was fed a smaller amount did well on the ration until the end of the experiment. From the results summarised in the following Table, it must be concluded that the heads of kafir (a variety of sorghum), are too bulky a feed for lambs. Lot IV (22 lambs) fed on kafir grain yielded a net profit of 10.34 dollars above that obtained from Lot III (22 lambs) which were given kafir heads. The most important result of the experiment was the discovery that the use of silaged darso (a variety of sorghum), reduced the cost of the increase in live-weight. This is seen by comparing Lots III and IV, which were given darso silage, with Lot V which had none.

III. EXPERIMENTS IN FEEDING AND BREEDING SHEEP AND GOATS. — The experimental work in sheep husbandry was begun by the Bureau

course to any hypothesis as to the amount of productive energy used in the formation of fat, or to any other hypotheses. When the composition and digestibility coefficients are known, it is possible to estimate the fat-producing value of a given food, but in order to simplify the calculation, PRAPS suggests the use of a factor called the "digestibility coefficient", which may be defined as follows: "the factor which multiplied by the food percentage gives the productive value of this food expressed in terms of fat". As the productive coefficient is calculated from the coefficient of digestibility, all that influences digestion also influences the productive coefficient. In the same way, some foods may be regarded as mixtures of two or more ingredients with different digestibility coefficients and different productive values. Non-decoricated cottonseed cake may for instance be regarded as being the residuum of the decoricated seeds plus the integuments of the seeds; the amount of the latter can be estimated from the crude fibre present. Since decoricated seeds and their integuments have different productivity coefficients, the amount of crude fibre will affect the productive coefficient of the feed.

There are similar variations in the composition of other feeds which depend on their different constituents which vary in digestibility and productive values. A table is given showing the productive coefficients based on the average coefficients of digestibility. One column shows the correction method employed for crude fibre, N-free extracts or for both, occasion arises. — *Experiment Station Record*, Vol. XXXV, p. 561, 1916.

of Animal Industry of the United States in 1906, in collaboration with the Wyoming Experiment Station at Laramie. There are at present 2 sheep-farms (one at Beltsville Md., and one at Vienna Va.) where the Government is carrying on experimental work in breeding and flock management. The studies include: farm sheep — range sheep — wool and other animal fibres — milch-goat investigations.

The farm flock studies include sheep on temporary pastures, flushing (extra feeding of pregnant ewes) and other means of increasing lamb yields nutrition studies in the growth of sheep, type-fixing in Southdowns and improvement in length of staple and quality of Southdown fleeces.

*Results of Feeding Experiment with Castrated Lambs.
Length of Experiment 96 Days.*

Lots	Ration of Concentrates per head and per day	No. of lambs	Average initial weight per head		Average daily increase per head	Cottonseed cake	Kafir	Sudan Grass	Lucerne hay	Silaged lucerne
			kg.	gm.						
I	170 gm. cottonseed cake	21	27.6	90	1.88	(1)	9.29	—	11.51	—
II	250 gm. cottonseed cake	22	26.4	97	2.58	(1)	8.32	—	9.76	—
III	380 gm. kafir heads.	22	25.4	138	—	2.76	—	6.38	7.21	—
IV	360 gm. kafir grain.	22	25.5	151	—	2.37	—	5.88	6.53	—
V	410 gm. ground kafir	21	26.4	152	—	3.00	—	—	9.98	—

(1) Small quantities of kafir were given during the last 18 days of the experiment.

Many good shepherds practise flushing ewes both before and during the breeding season, others, however, do not believe that the advantages are sufficient to justify the practice. In order to throw some light on the question, the Bureau of Animal Industry made an experiment at Beltsville Farm. A total of 302 matings have been studied with the following results. The value of flushing comes largely from the increasing number of turns; 78 % of the ewes with twins lambled in the first half of the lambing season and those that were in best condition were the first to come on heat.

Lamb yields were sufficiently increased to more than balance extra cost of food consumed. Dry feeds gave practically the same results as grass or other green feeds. Ewes given extra rations two weeks before the breeding season began, and throughout the mating season made an average gain of 3.2 kg. per head. At market age the twins averaged considerably less than the singles, but there was practically no difference between twins and singles when fully developed. Records failed to show that twin ewes were more prolific than singles.

Twin lambs do not fatten as early as singles if well nursed from birth. The Bureau of Animal Industry is endeavouring to produce a type of Southdown uniform in colour markings, of large size and having a dense

fleece with a long staple. So far the light colour markings of the face and legs is practically fixed and the fleece is 20 % heavier and the staple longer than that of the foundation flock.

The range sheep investigation was begun in connection with the Wyoming Experiment Station and transferred later to the Federal Station at Idaho, where the Bureau is conducting experiments along 4 distinct lines as follows:

- 1) Breeding a type of Rambouillet with desirable mutton form.
- 2) Studying types of cross-bred sheep for the purpose of producing the type best suited to range conditions.
- 3) Comparing methods of utilising land for sheep-raising and methods of supplying water on dry ranges.
- 4) The production of crops on arid land that may be used for winter feeding of sheep.

Good results have already been obtained as regards the first problem, wool and mutton production having already been improved.

In 1914, a flock of Corriedale sheep were imported from New Zealand to serve as a foundation flock at the Dubois Station. The fleeces from their offspring now average about 10 lb. with a shrinkage of about 50 %. Much progress has been made in adapting these sheep to the ranges of the Western States of the Union.

Ewes of the Rambouillet breed were crossed with rams of the long-wool breeds including Lincoln, Cotswold, Leicester and Komney-Marsh. After a few years experience with these rams the best Lincoln-Rambouillet rams were mated with the best ewes of the same cross and the progeny of this cross have received the name of Columbia.

Columbia lambs weigh 10 to 12 lb. heavier at weaning time than Corriedales. Columbia sheep on the whole are noted for size, mutton conformation and strong constitution. The choicest offspring resulting from the mating of Corriedale rams and Lincoln-Rambouillet ewes have been selected for the Corriedale-Columbia cross. The offspring from this combination are superior to the Corriedale in size, conformation and constitution. The Government will continue this work in the hope of breeding a type superior to either the Corriedale or the Columbia. All these cross-bred types have the flocking instinct and are well adapted to range conditions.

On the 28 000 acre ranch near Dubois, 5 fields of 80 acres each and one of 320 acres have been fenced and are being studied as to carrying capacity and for comparison of grazing under fence versus open range conditions. These fields are reseeded and furnish much more feed than unfenced ranges.

Sunflower silage is said to be an excellent winter feed for sheep.

At the Vienna Station (Virginia) Dr. Cooper CURTIS has found that it is possible to rear a fine flock of sheep in districts infested with stomach worms if the sheep are drenched once a month with a bluestone solution. A 24 % solution is prepared and kept in tightly-stoppered bottles. When required for use, it is diluted with 20 times its volume of water. Three and a half ounces of the diluted solution are given to each sheep weighing

90 lb. or more, lambs of 40 lb. can be given 1 oz. and for each additional 10 lb of live weight, $\frac{1}{2}$ oz. should be added. This treatment must be discontinued 2 weeks before lambing.

In 1919, experiments were made in crossing American female goats with pure-bred Saanen and Toggenburg males. The best native goats only give 1 $\frac{1}{2}$ lb. of milk daily but first cross goats gave on an average 3.15 lb. a day. After 2 years, the animals gave 3.9 lb. per head per day and the lactation period lasted about 9 months. F. D.

296 — **Sorghum as a Pig Food.** — POULAIN, A., in *Journal d'Agriculture pratique*, Vol. II, No. 47, p. 438. Paris, November 26, 1921.

As the result of experiments made at the piggery of the Experiment Centre of Fontmarie (Bouches-du-Rhône), the author arrived at the following conclusions.

Physiological effects. — Judging from the excrement, sorghum is one of the most cooling foods. It has the rare virtue of permitting the systematic use of peanut cake and the forcing of development without undue strain on the organism.

Feeding sows. — After trying various mixtures of sorghum, wheat bran and peanut cake, the author adopted the following: sorghum 66 % + bran 22 % + pea-nut cake 12 %, fed in the proportion of 2 % of the weight of the animals and supplemented by a grass ration of the same weight.

Nursing-sows receive an extra meal varying according to the number and age of the litter. With these rations the average weight at birth of the young pigs in a litter of 10 is 1.300 kg. in the case of hybrid sows (Marseillais Large White Yorkshires), the average weight usually being 1.200 kg. The conditions are evidently favourable for lactic secretion and the growth of the piglings, since litters of 7 or more weigh on an average 7 kg. at the age of 1 month.

Feeding of young pigs. — 1) Before weaning, little pigs living in the open do best on a mixture of 70 % sorghum + 30 % sharps. They will eat it from the third week; and a litter fed with this mixture will weigh 14 to 17 kg. at the end of 60 days with a graduated ration of 0 to 600 gm. per day (0 at the beginning and 600 at the end when they are weaned) only limited by the appetite of the piglings.

2) *After weaning.* The transition period is bridged over without any danger to the animals if peanut cake is added in the proportion of 20 % of the weight of the sorghum.

A daily ration of 1200 gm of sorghum + 400 gm bran + 300 gr. peanut cake fed to animals weighing 40 kg. has increased their weight 410 gm to 500 gm. per day in the case of breeding animals of the pure Marseillais race or crossed with Large Whites. The rations were given 3 times a day and the pigs were turned out into a yard for exercise after each meal.

From these experiments it may be gathered that sorghum mixed with peanut cake in the proportion of 4 : 1 can be substituted advantageously for palm-oil cake. This mixture added to sharps seems to be one

of the best in the climate of Southern France for rearing pigs, until the fattening period.

F. D.

297 — **Suggestions with a View to the better Notation of the Shape of the Silkworm Cocoon and of Its Variations.** — FIGORINI, L. (R. Stazione Bacologica Sperimentale di Padova), in *Informazioni seriche*, Vol. VIII, No. 22, pp. 333-334, figs. 3. Rome, November 20, 1921.

The author in the course of his crossing experiments begun in 1919, found it necessary for the better notation of the shape of the cocoon to substitute for the description and the absolute figures giving the dimensions, the transverse diameter in the case of the cylindrical, ovoid, and spherical cocoons and the measures of the diameter of the inflations and of the constrictions in the constricted forms, these measures being always expressed in hundredth parts of the long diameter.

In continuing his researches, the author realised that this notation, or "characteristic", was also insufficient, as it fails to indicate whether a cocoon is spherical or cylindrical in its median portion, the greater or less distance of the inflations from the poles in constricted cocoons, etc.

The author proposes to continue to express the longitudinal diameter by 100 and to mark off (in hundredths of the longitudinal axis), the transverse diameters at given distances on the long axis. This second measure is expressed by a factor having as its numerator a figure giving the decimal division on which is marked the transverse diameter, whereas the denominator gives the value of this diameter. In the case of symmetrical cocoons, 5 notations are made, at 10-20-30-40-50 centimeters respectively of the longitudinal axis; in that of asymmetrical cocoons, 10 notations are made, one at every 10 centimeters of the longitudinal axis.

In order to make these determinations, it is necessary to project the magnified image of these cocoons upon a screen and from this image which is outlined in pencil, the measurements are taken. In this manner the author obtained for 2 commercial crosses, the data given in the following Table.

Transverse Diameters of the Cocoons of Two Commercial Crosses.

Position of the transverse diameter on the longitudinal diameter	Gold Chinese	Yellow native	Cross Chinese Gold x Yellow native	White Chinese	Semi-spherical native	Cross white Chinese x Semi-spherical native
10						
100	46.4	38.6	39.6	45.8	46.8	41.7
20						
100	59.3	48.2	51.0	59.2	59.6	54.8
30						
100	66.0	50.8	55.3	66.6	65.6	61.3
40						
100	69.0	49.5	56.3	70.0	68.1	63.8
50						
100	70.2	48.8	54.9	70.8	68.6	61.0

These data show that in the cross Gold Chinese \times Yellow native, the cocoons are intermediate in shape between the those of the parents, whereas in the cross White Chinese \times semi-spherical native, the cocoon tends towards a new type in which the transverse diameters are reduced as compared with the longitudinal diameter and constriction makes its appearance.

F. D.

298 - A Simple Method of Obtaining Several Generations of Silkworms in the Same Year (1). — DE ZULUETA, A., in *Boletín del Museo Pedagógico de Ciencias naturales*, Vol. I, No. 6, pp. 1-2, fig. 1. Barcelona, March 1921.

The author has succeeded in rearing 4 generations of strong silkworms by the adoption of the Japanese method which consists in getting the moths to deposit their eggs on paper and immersing both paper and eggs (4 to 5 hours after the eggs are laid), for 5 seconds in water at 55° C (2). The eggs are then allowed to dry and kept in a warmish room.

The caterpillars hatch out at the end of 12 to 15 days. In this way the author obtained a 4th generation in December.

In the August rearings (2nd generation), care must be taken to keep the surroundings damp, in order to prevent the young mulberry leaves withering too quickly.

To obtain leaves for the 3rd generation it is necessary to prune the mulberry-trees a month before the young caterpillars hatch out, a plentiful supply of fresh leaves being thus obtained. Artificial heating is needed for rearing the 4th generation and the temperature must be kept at about 20° C.

F. D.

299 - Crossing Experiments with Varieties of Silkworm Having Bivoltine Males in Italy. — PIGORINI, L. (Direttore della R. Stazione bacologica sperimentale di Padova), in *Nuovi Annali del Ministro per l'Agricoltura*, Year I, No. 1, pp. 133-146. Rome, 1921.

This paper is a continuation of the author's previous article entitled Crossing Experiments with Varieties of Silkworms having Bivoltine Females (3). As in the preceding case, the object of the author was not to arrive at general conclusions, but rather patiently to collect the materials that are the fruits of observations made with the greatest care and hence of undoubted value, and capable some day of forming the basis of researches undertaken to determine the laws governing the phenomena of hybridisation in *Bombyx mori*.

At the same time that the author was making his crosses the previous year with female bivoltines and annual males, he carried out rec-

(1) See: *Boletín de la Real Sociedad Española de Historia natural*, Vol. XX, p. 306, and "Tomo del Cincuentario" of the same Society, pp. 495-501.

(2) It is even better to plunge the paper with the eggs first into warm water (54° C), then into cold (20° C) water, then repeat this process. Duration of each immersion 25 seconds. (Author's notes)

(3) See R. Sept. 1920, No. 900, (Ed.)

procal crosses with the same lots of cocoons ("Gran Sasso" and White Bivoltin excepted) viz.:

Golden Chinese female with greenish-white male bivoltine.

White Japanese female with bivoltine males, viz. greenish-white, with gibbous caterpillars, white Chinese, mixed white, yellow.

Ascoli female with male bivoltines: white with gibbous caterpillars, white Chinese, mixed white, yellow.

In all 12 crosses. The caterpillars had been hatched the previous spring.

The new characters of the cocoons were the object of these researches viz.:

The size and shape, taking the total of the 780 cocoons resulting from the crosses.

The colour, determined on 5 gm. of the outer silk and fibrin per cross.

The weight of the outer silk and fibrin, determined on 480 cocoons.

Length of reelable silk and standard, determined on 390 spun cocoons.

Strength and elasticity, determined on the silk of 195 cocoons (1264 determinations),

Three out of the 9 characters studied behaved in the same manner in the two sets of crosses (bivoltine female \times annual male and the reciprocal crosses), while 6 behaved differently in both cases. If we add to these characters that of bivoltism, which persisted in the first case, but was lost in the second, it is evident that by transposing the males and the females in the crosses, very dissimilar products are obtained, since most of the characters behaved differently in the two cases.

The size of the cocoons and the amount of crude fibrin in the raw silk were characters behaving in a similar manner in both kinds of crosses, being intermediate and attaining the average. On the other hand, two other characters that were linked with them in the female bivoltine crosses were separate in the male bivoltine crosses. One of these is shape, which had attained the average in the preceding crosses, only deviating from it in the direction of the shape of the strangled parent independently of its sex. Thus the character "strangled" is the dominant. The other is the standard; this is considerably higher than the calculated average and shows a distinct inclination to approach that of the annual females. There were two intermediate characters, but they were below the average and inclined to the maternal character observed in the female bivoltine crosses viz., the weight of the outer silk, and the length of the reelable silk. Neither can be classed in the same manner in the present crosses. It is true they remained intermediate and different from the average; in one of them, however, the weight of the outer silk still inclines towards the maternal character, but has risen a little above the average, whereas the in other, the length of the reelable silk has fallen below it, but shows an inclination towards the paternal character. As the length of the reelable silk was less in bivoltine than in annual silkworms, it must be concluded that this character has been affected by the bivoltine parent in the crosses.

The author found that in female bivoltine crosses one character, the strength of the silk, was intermediate, deviating from the average, being higher and showing a tendency towards the paternal character.

In the male bivoltine crosses strength of silk remained intermediate and above the average, but since the greatest degree of strength is a character distinguishing annual breeds to which the females belonged in these experiments, it may safely be said that it is the annual breeds with their "stronger tenacity" that have been dominant in determining the strength of silk of the hybrids. The elasticity remained such as it was in the female bivoltine crosses viz., a non-intermediate character greater than in the case of either parent.

The question of colour is more complex. In the female bivoltine crosses the colour was not determined from the external appearance of the cocoons, but by extracting and estimating the colouring matter. It did not prove to be an intermediate character, but one with higher value than that of the paternal and maternal cocoons; these taking the total of the cases studied, attained 84 % of the sum of the parents' characters. Also in the present case this character was not intermediate; contrary to what occurred before, the average figure of all the observations was below that of the male bivoltines. On examining the phenomenon more in detail, the author found that when the annual breed produced males, the hybrid cocoons contained more colouring matter and when it produced females there was less colouring matter present.

To sum up. Whether bivoltine females were crossed with annual males, or bivoltine males with annual females was a matter of indifference as regards certain characters (size of cocoons, amount of fibrin in the raw silk), but not as regards others. In the first case, the two parents have the same effect upon the hybrids. In the second, either the sex of one of the parents exercised a special influence (weight of outer silk tending towards that of the females), or a new character has found its way into the offspring and dominated the opposite character, such as constriction in crosses between annual females and a bivoltine male, or else one breed imposed its character on the other, for instance, the length of the reelable silk has been increased by the bivoltine parent and the strength of the silk by the annual parent. In the case of elasticity, crossing on one occasion clearly shewed the determining factor conferring upon the character of the hybrids a higher value than that of the parents. Finally, a mixture of sex influence: the monovoltism and bivoltism of the two breeds crossed determined the special behaviour of the colouring matter. All these facts lead to the following modification of the schedule at the end of the preceding article:

A. — INTERMEDIATE CHARACTERS.

- a) *Attaining the average:*
 - Size of cocoons.
 - Percentage of crude fibrin in the raw silk.
- a2) *Sometimes attaining the average, sometimes inclining towards a special character in one of the parents, or one of the breeds:*
 - Shape.
 - Standard.

b) *Deviating from the average:*

b₁) *Below or above the average and tending towards a maternal character:*

Weight of outer silk.

b₂) *Below the average and inclining towards the breed, but with less pronounced character:*

Length of reeleable silk.

b₃) *Above the average and inclining towards the breed, but with more pronounced character:*

Strength of thread.

B. — NON INTERMEDIATE CHARACTERS.

a) *Superior to the characters of either of the parents:*

Elasticity of thread.

b) *Superior or inferior to the characters of the parents, and at the same time, associated with the monovoltinism or bivoltinism of the breeds crossed and with the determining sex:*

Colour.

F. D.

300 - **Connection between the Hour of Gathering Mulberry Leaves and the Silk Yield of *Bombyx mori*.** — SACCHI, R. (Laboratorio di Bachicoltura del R. Istituto Superiore Agrario di Perugia), in *Le Stazioni sperimentali agrarie italiane*, Vol. LIV, Parts 7-10, pp. 316-325. Modena, 1921.

In preceding experiments the author had found that silkworms fed on leaves picked in the evening instead of at day-break, produced a greater weight of cocoons per ounce of eggs and a larger quantity of silk on reeling (1). He has continued his studies and supplemented them by analytic researches on the chemical composition of mulberry leaves picked at sunrise and sunset, and gives the results in the report analysed.

The data obtained confirm the statement that feeding silkworms (yellow Ascoli) with mulberry leaves gathered at sunset rather than at dawn, increases the weight of the cocoons; in one experiment 3.225 kg. of cocoons per gm. of silkworm eggs was obtained as against 3.025 kg.; and in another 2.640 kg. as against 2 kg.). The cocoons were larger and more uniform, and the silk layer was thicker; 15.66 % as against 15.39 % in one experiment; 17.6 % as against 16.8 % in another. These cocoons also produced moths that laid a larger quantity of eggs; average weight of one laying 0.478 gm., as compared with 0.426 gm..

These results depend on the fact that leaves gathered at sunset are more nutritious than those picked earlier in the day, as they contain more sugar, starch, dextrin, fats and proteins. The larger the number of days of full sunshine during the rearing of the silkworms, the more advantage is derived from giving them mulberry leaves picked at the close of the day.

F. D.

301 - **The Italian Sheep-Dog.** — MARCENARO, A. M., in *Bussa Corte*, Year II, Parts 47-48, pp. 985-986, Molassana (Genoa), December 1921.

These are two varieties of sheep-dog in Italy; the Alpine and the Maremma.

The Alpine sheep-dog or "Cravino" of Bergamo greatly resembles in its general characters the French dog of la Brie, and performs the same services as the "bouvier" dog. It is a strongly-made, tall animal (about

(1) See R. May 1919. No. 629. (Ed.)

60 cm. in height), with thick neck, prominent withers, solid haunches, broad thorax and strong limbs; its coat is long and curly, and variable in colour: whitish, black with spots, hazel-brown, dead-leaf brown. It would be well to select the darkest, most intense and finest colour.

The Maremma or Abruzzi dogs belong to the same bred according to the author although more agile and lighter, owing to the adaptation to local conditions that is of general occurrence in all mountain breeds.

The Maremma sheep-dog is over 60 cm. in height (at the withers it is 65 cm.). Its coat is woolly, pure white and glossy. It has a well-developed frame, and strong body with shortish, strong legs; its feet are round and close, with very hard pads. As it has broad, strong haunches, it would make an excellent draught-animal, but is never so used.

Hitherto, the sheep-dog has not been systematically bred in Italy (except for private use) nor has it been the object of selection.

A "Circolo per i cani da pastore italiani" (Society for Breeding Italian Sheep-Dogs), has therefore been founded at Genoa under the auspices of the "R. Comizio agrario".

F. D.

302 - **Breeding Fur-Bearing Animals in Canada in 1920** (1). — COATS, R. H. (Dominion Statistician), in *Canada Dominion Bureau of Statistics, Fur Branch*, 23 pp. Ottawa, 1921.

In 1920 there were 587 breeding establishments in Canada. Foxes were bred at 578 of these, martens at 6, muskrats at 2 and Karakul lambs at 1. In this list are included not only establishments solely devoted to breeding, but also farms where the raising of fur-producing animals is carried on at the same time as ordinary agricultural work. On December 31, 1920, the value of the fur animals in captivity was 4 722 905 dollars, most of this sum viz. 4 536 417 dollars being represented by the silver foxes.

The total value of fur animals sold by the breeders in 1920 was 763 221 dollars, of which 750 123 dollars were paid for silver foxes, 12 913 dollars for cross foxes and 185 dollars for other species. By estimating the average sale-price at each establishment it is found that the price of a silver fox varies between 100 and 1100 dollars. In 1920, 11 000 fur animals were born in captivity, 1618 died and 2322 were killed — the number of pelts sold during the same time was 2 470; the skins brought in 388 335 dollars; of this sum 373 140 dollars were paid for silver fox skins alone, each of which fetched from 75 to 750 dollars. At the end of 1920, the fur-breeding establishments were worth 5 925 496 dollars; the value of the land and buildings being estimated at 1 202 591 dollars, and of the animals in captivity at 4 722 905 dollars. The distribution of this industry in the various provinces is as follows as regards number of establishments: Prince Edward Island 309 — Nova Scotia 55 — Quebec 80 — New Brunswick 57 — Ontario 42 — Manitoba 2 — Saskatchewan 2 — Alberta 15 — British Columbia 11 — Yukon 14 — Total 587.

G. A. B.

(1) See R. August 1921, No. 846. (Ed.)

- 303 - **Horse-Chestnuts as a Food for Rabbits.** — LAMBERT, C., in *La Revue Agricole*, Year 32, No. 1, pp. 16-17. Paris, January 1, 1922.

The author found that the rabbits on his farm at Marville-les-Bois (Eure-et-Loire), would eat horse-chestnuts, provided the bitter principle was removed by boiling. The horse-chestnuts are passed through a root-cutter adjusted to give a light cut and they are then boiled in salt water and the resulting mass is crushed. This paste is fed sprinkled over with wheat bran. The horse-chestnuts are boiled every two days. This feed is supplemented with dry hay, broom and sliced beets.

The chestnuts have to be dried as soon as they are collected, so that they may be kept in heaps but at the same time free from damage by mould. Once this ration is fed it must be continued and not given in turn with any other food.

F. D.

FARM ENGINEERING.

- 304 - **Condition of Motor-Cultivation in Germany.** — I. MARTINY, *Der Stand des Motorpflugwesens*, in *Mitteilungen der Deutschen Landwirtschafts-Gesellschaft*, No. 25, pp. 391-394; No. 26, pp. 405-409. Berlin, June 18, and 25, 1921. — II. COLSMAN, *Der Stand des Motorpflugwesens*, *Ibidem*, No. 27, pp. 420-422, July 2, 1921. — III. CLEVE-GRAUBOF, *Der Stand des Motorpflugwesens*, *Ibidem*, No. 27, pp. 422-423. — IV. KAUL W., *Der Stand des Motorpflugwesens*, *Ibidem*, No. 27, pp. 423-425.

I. — The author reports on the large number of agricultural machines and implements that have accumulated at the factories, and asks how this stock can be turned to account. Customers have been deterred from purchasing by the hope that prices will fall which however in his opinion, is not likely to occur.

He considers that about half the owners of mechanical cultivation machines are dissatisfied with them; this is due to the fact that the farmer does not understand his machine and the driver has not had the necessary mechanical training. Another cause of dissatisfaction is to be found in the poor quality of the oil. The owner also complains that he does not get the returns he expected, and that the engine is not sufficiently powerful. The author makes a comparative study of the apparatus for motor-cultivation, first contrasting the work of a plough with that of a mechanical rotary.

Among the machines using mould-boards for tilling the ground, he mentions the SROCK motor-plough, the HANSA-LLOYD tractor, the W. D. and the Ergomobil machines working on the same principle as the steam-plough.

The author also speaks of some of the latest tilling machines such as VOGELER's motor-plough, KOSTO's tractor with a single driving-wheel, the BENZ tractor, the FREUND motor-plough, the DEUTZ tractor, PODEUS's caterpillar tractors. The following machines also have new features: the BUSSARD motor-plough, the LANZ tractor, the EULM tractor, the VIAG machine, the RICHTER tractor etc.

The manufacture of light tractors is a matter of great economic im-

portance; two have already been turned out; the RÜTTGER tractor and the KÖRTING motor-plough.

The position of the mechanical cultivation industry is a very difficult one and is still further threatened by the possible introduction of American machines, especially the FORD tractor.

The only means of improving the situation would be an agreement between the manufacturers of machines of the same type.

II. — The author mentions the unsatisfactory results often obtained with mechanical cultivation. The chief cause of these failures is the lack of good drivers. In order to obtain well-trained men, it is necessary to offer them payment comparing favourably with town wages and to make them feel at home in the country by providing them with a comfortable house, a small plot of ground etc.

The author is very anxious that the German Agricultural Society should experiment in the mechanical tilling of the subsoil and in breaking up the stubble by means of flexible apparatus.

III. — The author describes the working of the HANSA LLOYD tractor, provided with a 25 H.P. engine, on his own estate of 350 hectares.

Ploughing: with 3 or 4-furrow ploughs, 2 to 3 hectares per 10 hour day.

Breaking up stubble: with 9-furrow-plough and a harrow, 4.5 to 7 hectares.

Preliminary work in the spring: 10 hectares per day. For ploughing the fuel consumption is estimated at 28 kg. per hectare, 1 ½ kg. of lubricating oil being used per day.

The saving effected by the use of a tractor is greater, the longer the machine is used. The author trusts that the working expenses will be reduced as soon as possible, but hopes this end will be attained by tractors constructed in the country such as LANG's light tractor.

IV. — CLEVE-GRAUHOFF describes his own experiences with: the STOCK motor-plough (old and new type), the VOGELER motor-plough, the HANSA-LLOYD tractor, and the FODEUS caterpillar tractor. He emphasizes the necessity for constructing light machines. G. B.

305 — American and German Agricultural Machines. — BILAU, K., in *Deutsche Landwirtschaftliche Presse*, No. 13, p. 88, Berlin, February 11, 1921.

In view of the possible introduction into Germany of light American tractors, the author examines the two following questions.

1) Would the introduction of a cheap light tractor be detrimental to the German mechanical industry?

The purchaser enquires before buying a plough, how much work it can accomplish, how long it will last and its net cost. Tractors are now the fashion whether this preference can be justified or not.

The fundamental difference between tractors of foreign construction and those made in Germany is that they are lighter and develop a lower H. P. At the English Meeting of 1919, 81.15 % of the tractors were

machines of between 20 and 30 H. P. The German tractors are both more powerful and heavier, as is shown by the Table appended to the article.

If powerful machines work more economically, it must not be forgotten that the German tractors are more expensive to buy.

A start has now been made in Germany with the manufacture of lighter tractors.

2. — In what way is it possible to protect German trade from this danger? In the first place by making lighter and also cheaper machines, with at the same time an increase in the return. G. B.

306 - **The Construction and Use of Agricultural Tractors in Italy.** — LEOPARDI, R., in *La Macchina nell'Agricoltura*, Year 1, No. 10, pp. 6-8, Milan, December 1921.

The author considers that one of the chief reasons why agricultural tractors are little used in Italy, is that all the machines on the market are of nearly the same power, the engine developing about 25 HP, and the attachment bolt 15 H P, whereas in the different districts and various conditions of agriculture in the country, the average motor power required is between 25 and 60 HP.

This mistake is due to the fact that the manufactures have been influenced by statistics of construction in the United States, where according to the data collected by the "Federazione italiana dei Consorzi agrari" of Piacenza (*Il problema della motocultura e la trattrice agricola Fiat*), 80 % of the tractors constructed develop 12 to 24 H.P., 14 ^{0/5} 24 to 40 H.P., and 6 % over 40 H.P. Too little attention has been paid to the fact that the soils of Italy differ very greatly in character from those of North America and that the plough therefore needs more traction force. In recent years also fewer 25 HP, types have been constructed in the United States, while a larger number of the more powerful tractors have been turned out.

In order to determine the minimum force required, it is necessary to take into consideration: 1) economy of labour; 2) rapidity of work; 3) the average soil resistance.

1) In practice one man is not sufficient to manage a tractor, two normally being required in order to save undue loss of time in the event of unavoidable accidents. The two men in charge of a tractor receive the same wages as three peasants doing the same work with a team of animals. The saving of labour thus begins in the case of a tractor from the moment it can draw a two-share or three-share-plough for deep ploughing, or a four-share or five-share-plough for superficial cultivation.

2) In order to do the work at the right time, it must be possible to execute it quickly; the most useful speed for tractors is reckoned at 3.6 km. per hour.

3) From experiments carried out in Italy (at Melegnano, Lodi, etc.), the following data have been obtained as regards soil resistance: in deep ploughing, from 60 to 70 kg. per sq. dm. of the cut; in superficial ploughing from 40 to 50 kg. per sq. dm. From these data it is possible

to calculate the minimum force required from a tractor for the various cultural operations.

Allowing for: a speed of 3.6 km. per hour (1 metre per second), a depth of 70 cm. for deep ploughing and 20 cm. in the case of superficial ploughing and a cut 30 cm. in width for each share, we should have the following cases:

A. -- For deep ploughing:

a) with one-share tractor: cutting 9 sq. dm.; power necessary at attachment bolt $9 \times 70 \times 1 = 630$ kilogram-seconds.

b) with 2 share tractor: cutting 18 sq. dm.; power necessary at attachment bolt $18 \times 70 \times 1 = 1260$ kgm-sec.

c) with 3 share tractor: cutting 27 sq. dm.; power necessary at attachment bolt = 1890 kgm-sec.

B. -- For superficial ploughing: d) with 2 share tractor: cutting 18 sq. dm.; power necessary at attachment bolt $18 \times 50 \times 1 = 900$ kgm-sec.

e) with 4 share tractor: cutting 24 sq. dm.; power necessary at attachment bolt $24 \times 50 \times 1 = 1200$ kgm-sec.

f) with 5 share tractor 30 sq. dm.; power necessary at attachment bolt $30 \times 50 \times 1 = 1500$ kgm-sec.

It is necessary to provide a little extra power to meet unexpected increases in resistance. If these are allowed for by increasing by $\frac{1}{4}$ the powers given above, the figures become respectively: 790 — 1580 — 2370 — 1125 — 1500 — 1875 kgm-sec.

With the best types of ordinary tractors, the average output would hardly exceed 50 %. Hence the engines generating the above-named powers should develop:

a) 1500 kgm-sec. or 21 HP.	d) 2250 kgm-sec. or 30 HP.
b) 3160 " " " 42 "	e) 3000 " " " 40 "
c) 4110 " " " 63 "	f) 3750 " " " 50 "

If to avoid a too heavy machine a one-share tractor only is used, it is at once seen, from what has already been said, that there ought to be at least 3 types of tractor on the market, of respectively: 15 to 25 H P; 17 to 35 H P; 22 to 45 H P.

The necessity of having at least these 3 types in order to satisfy the demand and requirements of different farmers depends on the fact that these tractors are also used for another important purpose, viz., to work the threshing-machines often coupled with forage presses. In order to work these machines the following powers are necessary:

0.75 Thresher with Press	15-18 HP.
1.01 " " "	18-20 "
1.07 " " "	23-25 "
1.22 " " "	26-30 "
1.37 " " "	30-36 "

Ploughing to a depth of 40-45 cm., could always be done with a one share tractor without giving up all the advantages afforded by an agricultural tractor.

F. D.

Landw. Presse, No. 17, pp. 122-123. Berlin, March 2, 1921.

portant :

	Light type	Two-wheeled type	Four-wheeled type
Type of engine.	With 2 strokes	—	—
Power.	18 HP	32 HP	32 HP
Number of revolutions per minute.	800	800	800
Speeds per hour. $\left\{ \begin{array}{l} \text{forwards km.} \\ \text{backwards km.} \end{array} \right.$	$\left\{ \begin{array}{l} 3 \text{ to } 5 \\ 3 \end{array} \right.$	$\left\{ \begin{array}{l} 3.5 \text{ to } 5 \\ 3.5 \end{array} \right.$	$\left\{ \begin{array}{l} 2.3-4.5-6 \\ 2 \end{array} \right.$
Number of driving-wheels.	1	1	2
Number of steering-wheels.	1 + (1 supporting wheel)	2	2
Weight of the machine kg	1150	1850	1950

pratique, Year 86, Vol. I, No. 4, pp. 78-80, figs 3. Paris, Jan. 28, 1922.

Work

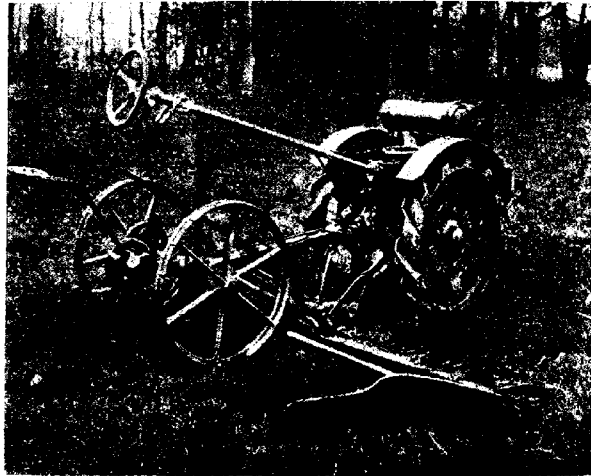
machines by means of a belt.

The driving-wheels are 1 m. in diameter, and their tyres are provided

(1) See R. Oct.-Dec. 1919, No. 1222, I. p. 1273; R. March 1920, No. 354. (Ed.)

with slanting protections ; they work conjointly with the axle or separately and independently of it, acting on handles attached to the centre of each wheel which uncouple the tractor, or cause it to go forwards or backwards by adjustments in the pawl-boxes of the nave. There is no speed-gear, and the turning radius is very small the turning being carried out on one wheel.

To this fore-carriage are attached various agricultural machines: provided with a seat from which the driver can work the unreversible steering-wheel at the side of which are two handles, one for the carburettor, and the other for uncoupling.



Fore-carriage Tractor « Agro » attached to a reaper.

The total weight of the fore-carriage tractor is about 850 kg., its external width of 1.08 m. allows it to be used in vineyards, especially as it can turn on a very small radius.

To the fore-carriage can be attached, according to the work to be done, a one, two, or three-furrow two-way plough. The attachment of a single two-way plough for harrow ploughing is an easy matter.

To the back of the fore-carriage is affixed an attachment system for different agricultural machines : in the case of reapers or harvester-binders, the pole is replaced by a very short beam of which the front portion is shod with iron.

The working speed varies from 3000 to 4 500 m. per hour. According to information supplied, the following work could be done per hour:

[398]

ploughing to a depth of 0.25 m.: 10 *ares* — ordinary ploughing from 0.18 m. to 0.20 m.: 15 *ares* — breaking up stubble from 0.10 m. to 0.12 m.: 25 *ares* — with cultivator with flexible teeth: 30-50 *ares* — reaper and harvester-binder: 35-40 *ares*.

The hourly consumption of fuel would vary with the character of the work from 2.5 to 3 litres of petrol to which must be added 5 to 6 % of lubricating oil.

Several machines can be belt-driven even if the engine is left on its frame in the fore-carriage tractor, but it can easily be detached being kept in place by 4 bolts only, and put in any required position, if in communication with a supply of petrol.

G. B.

309 - **Power of the Engines of Tractors.** — PASSALEGUE, G., in *Journal d'Agriculture pratique*, Vol. 36, No. 36, pp. 212-214. Paris, September 17, 1921.

The numerous tests made of the engines of tractors at the Paris Machine Trial Station show that the maximum power obtained at the pulley is only $\frac{8}{10}$ of the force developed by the machine at the test-bench. Therefore, before purchasing a tractor it is well to consider its actual hauling power rather than the engine's record at the testing Station.

G. B.

310 - **Wedging a Tractor.** — RINGELMANN, M., in *Journal d'Agriculture pratique*, Vol. 1, No. 12, pp. 234-236. Paris, March 16, 1921.

The author mentions several ways of wedging a tractor working as a stationary machine. Of these the following method adopted in America is the most interesting. A piece of wood is applied to the outside of the tires of the wheels on either side. The wood is placed obliquely against the wheel of the largest diameter, it skirts the second wheel, and is buttressed on the ground. The beam is affixed to the tires by means of braces.

G. B.

311 - **Rear-driven Tractors.** — RINGELMANN, M., in *Journal d'Agriculture pratique*, Vol. 1, No. 14, pp. 275-276. Paris, April 9, 1921.

The author states the conditions to be fulfilled by a tractor in order that it may be driven from the rear, that is to say, from a seat on the machine towed by the tractor.

- 1) The engine must be provided with an automatic speed regulator.
- 2) Coupling and uncoupling must be effected by a rope if required.
- 3) It must be possible to prolong the steering shaft backwards.

G. B.

312 - **A Charcoal Gas-Engine for Tractors** (1). — GREILSAMMER, in *Journal d'Agriculture pratique*, Year 85, No. 41, pp. 318-319, 1 fig. Paris, October 15, 1921.

In the course of a public demonstration of Mechanical Cultivation given by the Association of Stockbreeders and Agriculturists of Indre,

(1) See *R.* Jan. 1922, No. 95. Other experiments with tractors running on poor gas and using charcoal have been carried out by the Agricultural Co-operative Society of Berry (Department of Indre). The tractor, provided with a gas-engine, towed a 3-furrow plough

on September 23 and 24, 1921, the CAZES gas-engine, type D L, was tested at Châteauroux. This engine, which developed 30 to 40 HP, was mounted on a TOURAND-LATHI tractor with a 35 HP, 4 cylinder, petrol engine (of 0.105 m. bore, and 0.140 m. stroke at 1200 revolutions per minute).

The gas-engine and purifying apparatus are mounted on a platform at the back of the tractor.

The gas-engine consists of a sheet-iron cylinder with a non-conducting lining and a bottom without a grating having an opening in its circumference through which the steam is admitted. The boiler producing the steam is situated in the upper part and works on the principle of immediate steam generation, independently of the slope of the ground. The water feeding the apparatus flows through and falls drop by drop from a small copper pipe upon a grating pierced with holes that cover the boiler.

The steam thus produced passes through a cooler at the side of the gas-engine where it cools the heated gases that are travelling in the reverse direction. Then the steam at once finds its way to the bottom of the gas-engine.

The gases after passing through the cooler go through the scrubber, which is formed of a column of coke.

A fine rain falls upon the coke from a spiral cooler in the upper part of the scrubber which is supplied with water from the tank above.

On leaving the scrubber, the cooled and purified gases pass into a chamber where they come into contact with a number of U-shaped vertical pieces of iron upon which they condense, depositing droplets of water and small particles of tar. The gases are then conducted into a box containing horse-hair, wadding or other absorbent material, where they are finally purified and freed from the last particles of tar. Thence the gases pass into a mixer acting as a carburettor, where the required amount of air is added.

This mixer consists of a cylindrical chamber with an opening of varying size which is regulated by the displacement of a circular jacket. The air is drawn in through this aperture and mixes with the gas entering through a throttle-valve by which its flow is regulated.

The amount of gas and of air is controlled by two regulators worked by handles placed near the hand of the driver. This mixer, which is of very simple construction, works admirably and is less delicate than an ordinary carburettor.

The whole plant is completed by a ventilator worked by a handle (supplying the gas-engine with the air required for combustion and ignition), and by a funnel placed before the cooler and above the exit-pipe for the gases coming from the gas-engine.

on heavy soil. Depth of ploughing 15 c.m. consumption per hectare: charcoal 45 kg. water 50 litres. As the charcoal was bought at 0.22 fr. per kg. the cost of the fuel used was 9.90 fr. per hectare. — G. PASSEREAU, "Tracteurs à gaz pauvre", in *Journal d'Agriculture pratique*, Vol. 36, No. 39, p. 279. Paris, Oct. 1, 1921. (Ed.)

A tank with a capacity of 80-100 litres distributes the water to the scrubber and the gas-engine by means of regulating tap.

The gas-engine with its accessories takes up comparatively little space, the whole apparatus is about 1.55 m. high, 1.50 m. wide and 0.50 m. long; thus its volume is not much over 1 cubic metre.

The total weight of these engines is about 500 kg., and could be reduced to 400 kg. by decreasing the weight of the fire-proof clay lining.

The size of the CAZES gas-engine allows it to be used for all existing tractors, but it would have to be considerably reduced to adapt it for machines of about 20 HP.

The author's statements may be summarised as follows.

The maximum consumption, when ploughing with a 3-furrow plough to a depth of 0.15 m. and a breadth of 1.05 m., is 52 kg. of charcoal and 62 litres of water per hectare.

Another tractor, the TOURAND-LATH, which is identical but runs on petrol, drew a 4-furrow plough on the same day at the same speed, which would seem to show that the maximum loss of power in substituting poor gas for petrol would be 25 %.

Charcoal bought retail at 0.22 fr. the kg. in Châteauroux cost 11.45 fr. per hectare, as against 72 fr. paid for petrol. This represents a saving of 60 fr. per hectare, or 85 % on the fuel expenditure. F. D.

313 - On Accidents due to Tractors. — RINGELMANN, M., in *Journal d'Agriculture pratique*, Vol. 36, No. 29, pp. 71-73. Paris, July 23, 1921.

The author investigates the various accidents that have occurred, and advises in order to guard against mischance that the driver should keep his seat upon the machine in tow and not upon the tractor.

G. B.

314 - The "Buckeye" Tractor Ditcher for Land Drainage. Trials in England. — GARNER, H. V. (School of Agriculture, Cambridge), in *The Journal of the Ministry of Agriculture*, Vol. XXVIII, No. 4, pp. 306-320, Tables IV, figs. 2. London, July 1921.

Report of trials with this American machine conducted at Croxson, Cambridgeshire (England), following on highly successful results in Scotland.

The "Buckeye" tractor ditcher here described is designed on the rotating wheel system and the following is an abridged specification: 60 h. p. 4-cylinder petrol engine; digging wheel 11 1/2 in. or 14 1/2 in. wide x 4 1/2 ft. deep, or 11 1/2 in. wide x 5 1/2 ft. deep; length over all 25 ft.; width over wheels 8 ft. 6 in.; extreme height 8 ft. 9 in.; digging speeds 2 1/2 ft. to 9 ft. per minute; road speeds 1 to 1 1/2 miles per hour; approximate shipping weight 7-9 tons; width of front wheels 6 in.; width of extension tyres to front wheels 8 in.; width of caterpillar track, 22 in., centre of ditch to centre of spoil bank 4 ft. 3 in.

The chief points of the machine are as follows:— Substantial main frame and platform constructed of steel T-beams connected at intervals by crossbeams and strongly reinforced, carries at one end a 20 h. p. en-

gine unit and transmission system, and at the other the cutting wheel hinged to the platform. The frame and superstructure are supported at both ends on 3-point suspension trucks which eliminate severe twisting strains.

The digging wheel is mounted midway between the two main girders and is held in a 3-point suspension frame hinged to the main platform. Power is transmitted to the wheel by a system of chains running on sprocket wheels; by shifting a high speed chain from one set of a series of graduated sprockets to another, 4 digging speeds ranging from 2 1/2 ft. to 9 ft. per minute can be obtained. This plan is found to be very satisfactory and effective.

A feature of the transmission system is a safety device in the form of a friction cone clutch, which slips when the machine strikes an obstruction beyond its capacity, thus averting a breakdown. On the outside



FIG. 1. — « Buckeye » Tractor. Ditcher at rest.

rim of the digging wheel are mounted buckets of deep section which can be suitably equipped for varying classes of work.

Adjustment of the depth of the digging wheel is obtained by a hoist worked from the engine and operated through a double boom, the cables communicating with both the front and the rear of the wheel frame. If the wheel is rotated and lowered, keeping the forward end of the frame some 3 ft. lower than its rear end, the buckets will dig themselves into the ground at this angle as the whole machine is advanced. At some prearranged depth, the descent is checked by means of the front cables; the rear cables are then slackened, allowing the curved sole which follows the digging wheel to take the weight of the rear of the wheel and the mould and smooth the floor of the trench.

The method of adjustment in order to obtain a drain of even width when the machine passes over uneven land is described in detail. Follow

ing in the appended diagram, A B C represents an irregular surface below which the drain has to be cut. At intervals of about 50 yds. along this line, levels are taken, in the usual way. Having decided the fall required in the drain, the depths below the surface at which the floor of the trench must lie at A, B and C are calculated. (Suppose these depths are 4 ft. 6 in., 3 ft. and 4 ft. respectively, as in the diagram where F G

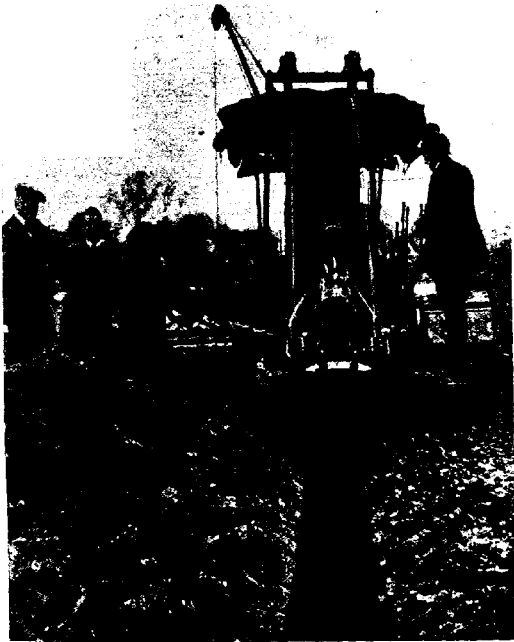


FIG. 2. — Buckeye Tractor, Ditcher at work, Back view.

presents the bottom of the drain and F H the horizontal). The movable cross members A X, B Y and C Z are adjusted in correlation with the horizontal sighting rod D fixed to the frame of the digging wheel E of the ditcher. If D is fixed 9 ft. above the level above the floor of the drain, A X, B Y and C Z must also be fixed at 9 ft. above the level at which the drain is to be dug; thus A X at point A will be 4 ft. 6 in. above ground, and B Y will measure 6 ft. above ground at B etc. The machine

is then moved to the outlet end A of the drain, since digging always proceeds uphill, and made to face along the line of standards. The digging wheel is made to cut its way into the ground; when the rod D intersects the line of cross-members, the further descent of the wheel is stopped by the winding gear. The ditcher now proceeds along the line of the proposed drain and it is important to keep the rod D constantly in alignment with the cross-members by raising or lowering the wheel E in accordance with the irregularities of the land. If this is done carefully a trench with an even fall can be excavated in a single operation.

In describing the methods to be adopted in dealing with this machine, it is noted that two men are sufficient for the actual working. Arrangements should be made to lay the drainage pipes close behind the machine, as delay in doing so will probably result in loose earth falling into the finished excavation.

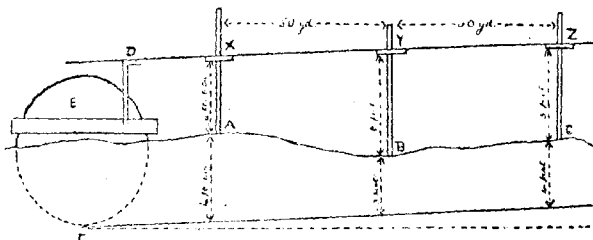


FIG. 3. — Diagram shewing the method used to regulate the depth of the trench when the Ditcher passes over uneven ground.

The trials were carried out on 2 types of demonstration field:

1) a 12-acre bare fallow of gentle and uniform slope; about 5 ft. of dry friable soil on the surface with moist and sticky clay below. In the upper parts of the field, bands of chalky gravel were found in the clay.

2) wheat stubbles with hard-baked clay surfaces resting on chalky clay. (The mechanical analyses of the respective subsoils is shown in tabular form).

It was subsequently found that the ditcher could operate more readily at any given depth in a dry clay subsoil containing chalk and gravel than in a wet clay subsoil. The machine proved itself capable of excavating straight trenches for land drainage to any depth not exceeding 4 ft. 6 in. but difficulty was found in excavating trenches with a curve approximating to a right angle and under such conditions, it is considered advisable to build a catchpit at the angle of the bend.

The rate of excavation measured in chains per hour obviously increases rapidly as the trench becomes shallower, the type of soil being

be same; the speeds vary according to depth and moisture of subsoil; 6 in. drains in moist clay were dug at the rate of 1.7 chains per running hour, and in dry clay at 3.0 chains per hour; 2 ft. drains in dry clay at 9 chains per hour. The rate of fuel consumption is roughly constant at all speeds varying from 2-2.8 gall. per hour. (The machine is fitted with an automatic cut-out, which acts like a governor and causes the engine to run at constant speed). Indications are also given showing how much work could be done under the various conditions of depth and soil if it were kept running *e. g.* for 7 hours per day. Under these conditions about 63 chains of 2 ft. minors could be dug in dry clay, or chains of 3 ft. 6 in. mains in similar clay or 12 chains of 3 ft. 6 in. mains in wet clay.

An attempt has been made on a conservative basis to estimate the costs of operating under commercial conditions, and they compare favourably with present costs of hand digging; the calculation is shown as follows:—

2 ft. 6 in. branches		in moist stiff clay where 1.7 chains were excavated per hour			
		cost 20s. 11d. per chain			
2 ft. 6 in.	"	similar clay	cost 10s. 2d per chain		
3 ft. 7 in.	"	dry clay	" 11s. 11d "	"	"
2 ft. 9 in.	"	dry clay	" 7s. 9d "	"	"
2 ft.	"	dry clay	" 4s. 0d "	"	"

It is noted that hand drainage is done at an average rate of 2 chains (2 ft. 6 in trench per day of 8 hours compared with Buckeye drainage in about 20 minutes.

The trial showed that the friction produced by the revolution of the digging wheel in moist clay greatly retarded the speed of work and raised the cost, but by fixing scrapers to the framework and adjusting them to remove the adherent clay from the sides of the wheel, much of the friction could be obviated. By fitting the drainer with a wheel and buckets capable of digging trenches 11 in. as a maximum and 8 in. as a minimum, instead of 14 ½ in. maximum and 11 ½ in. minimum, considerable economy of cost of operating might be expected.

The machine is not suitable for purchase by farmers unless operating on a very large scale; it is suitable for use by agricultural contractors or by landowners with large estates.

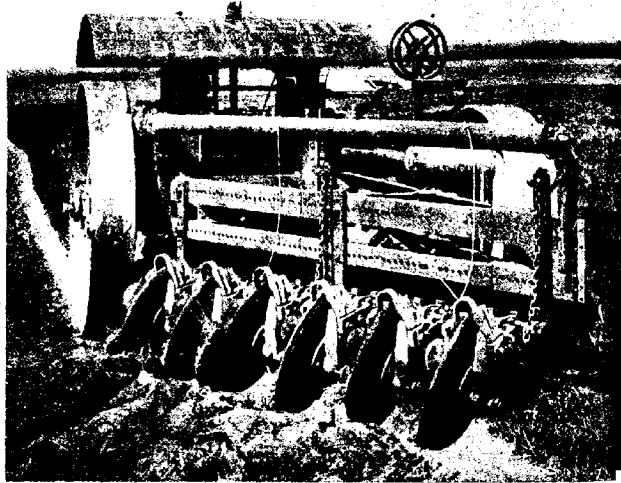
M. L. V.

15 - **Motor-Plough for Ploughing on the Flat.** — DESSAISIAUX, R., in *Journal d'Agriculture pratique*, Vol. 36, No. 38, p. 253. Paris, September 24, 1921.

Description of the Tournesol disk-plough with reverse or shuttle-motion.

This machine consists of a central portion including the engine with its accessories, as well as the driving-wheels, and of two symmetrical parts placed at each end, one of which works only when the machine is reversed and the parts of the other are removed from the soil. At the end of each furrow, the function of each working portion is reversed.

The central part includes the engine which sets in motion 3 driving-wheels, one on the side of the furrow, and two land-wheels, of slightly smaller diameter. These two wheels or one of them (the other remaining fixed) can be slanted by the steering-handles, which are each worked from one of the two seats successively occupied by the driver.



Tournesol Motor Plough: back view.

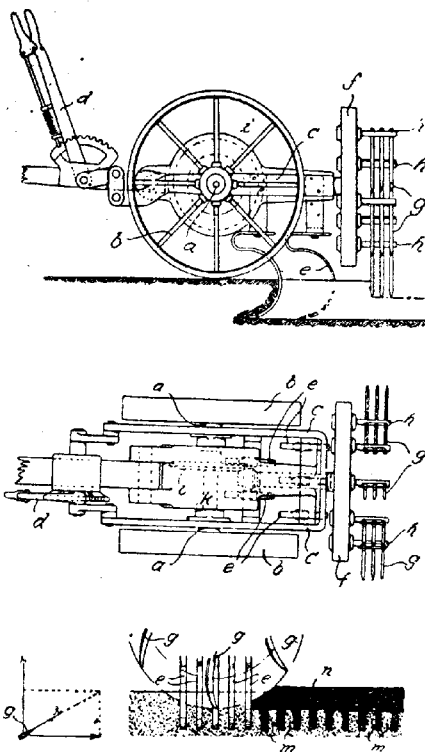
The engine is said to develop 30 HP.; it makes 1100 revolutions a minute, and has 4 vertical cylinders of 0.100 m. bore. The pistons have a stroke of 0.160 m. In continuous work this engine can develop 37.16 HP. It has two speeds; one of about 2500 and the other of about 4000 m. per hour. Total weight of motor-plough: about 4000 kg.

In the model represented in the figure, the working parts consist of mould-boards with disks mounted on either side on two frames that are raised at the end of the furrow by coupling the engine on a slanting tube acting as a windlass, around which are rolled the elevating cables. If the soil is very heavy and the ploughing deep, 3 disks may be used in place of 6.

Manufactured by: Société Delahaye, 10 Rue du Banquier, Paris G. B.

- 316 - **New Machine with Flexible Teeth and Rotating Forks.** — *Deutsche Landwirtschaftliche Presse*, No. 5, p. 33, Berlin, Jan. 19, 1921.

The manufacturer having noticed that experiments in loosening the soil have proved that it is not always necessary to turn over the earth as is usually done, has devised a new apparatus of which figures are given. It consists of a frame upon which are mounted the flexible teeth of a cultivator. These make a series of furrows, the loosening of the soil being subsequently effected by a system of forks similar to those attached to a potato-digger.



G. B.

- 317 - **Choice of Machines based on Spring Awakening of Arable Land.** — See No. 235 of this Review.

- 318 - **Pantziar Machine for Chopping and Distributing Manure.** — *Deutsche Landw. Presse*, No. 15, p. 106, Berlin, February 25, 1921.

This apparatus consists of a hopper in the form of a barrel mounted on 4 wheels. The interior of the hopper is covered with blades between

which pass other blades attached to a shaft, the movement of these blades setting the wheels in motion. On leaving the hopper, the manure passes into a funnel fitted with other blades that complete the work. It is distributed by means of a horizontal disk with a rapid rotary motion. G. B.

319 - **The Decortication of Beet Seed.** — RINGELMANN, M., in *Journal d'Agriculture pratique*, Vol. 1, No. 11, pp. 214-216. Paris, March 19, 1921.

The author discusses the advantages derived from decorticating beet-root seeds in such a manner as to set free the seeds contained in the glomerules, and describes the mechanical means to be adopted for the purpose.

As a result of experiments in hulling the different varieties of rice from Central Africa, Madagascar and Indo-China, he was led to try the same machines for the decortication of certain seeds (those of the beet, sainfoin, sulla and carrot) which are difficult to sow or reluctant to germinate. He found that the small model of the Neptune crusher (Messrs. PILTZER, Nevers) when properly regulated to 38 revolutions per minute, decorticated 5 kg. of Tunisian sulla and 6 kg. of Egyptian sulla per hour, these seeds being much harder to hull than carrot or beet seeds.

Another trial was made with the "Melchior" rice huller of the General Millstone-Makers' Society of Ferté-sous-Jouarre, Seine-et-Marne. The working part of the machine consists of a truncated cone with a vertical axis, the whole surface being covered with perforated sheet-iron. The fly-wheel fitted inside with 147 teeth, engages with a pinion of 27 teeth mounted on a small horizontal axis having at the end two angle wheels, which set in motion the vertical axis of the truncated cone (the decorticator). With a speed of 38 revolutions of the fly-wheel, 18 kg. of Tunisian sulla seed and 15 kg. of Egyptian sulla seed are decorticated per hour.

With these two machines from 7000 to 7300 kilogrammetres are needed for decorticating 1 kg. of sulla. G. B.

320 - **Haupt Potato-Planter with Cylindrical Hopper.** — *Deutsche Landwirtschaftliche Presse*, No. 11, p. 75, Berlin, February 9, 1921.

The drum containing the tubers for planting has on its circumference 8 openings corresponding to pointed funnels. The funnels when they come to the upper part of the cylinder, fall inwards from their own weight, and receive the potato. When they reach the bottom however they leave the drum, and the potato falls into the furrow. G. B.

321 - **Motor-Mowers.** — PASSELEGUE, G., in *Journal d'Agriculture pratique*, Vol. 35, No. pp. 31-36. Paris, January 13, 1921.

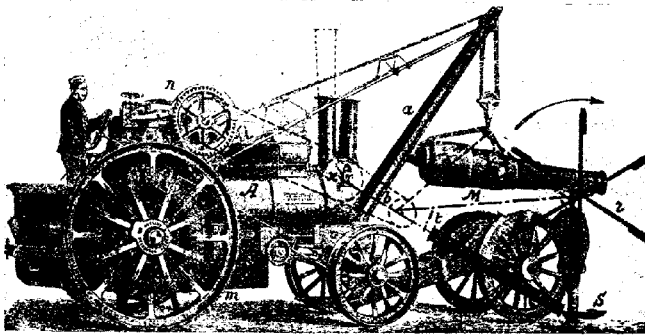
The author gives a description of the VALLOTTON and the FORD type of motor-mowers and refers to the results obtained in 1914 by RINGELMANN with the VALLOTTON mower.

Nature of Field	One year old Lucerne	Natural meadow
Average width of swathe.	1.04 m.	1.14 m.
Time taken to mow 1 hectare	4 hrs 30 min.	3 hrs 15 min.
Petrol consumed per hectare	4.85 kg.	4.56 kg.

322 - **Reaper-Binder for Tractor.** — RINGELMANN, M., in *Journal d'Agriculture pratique*, Vol. 36, No. 27, pp. 32-35. Paris, July 9, 1921.

The author discusses the question of the preliminary circuit of the field, and with the AVELING and PORTER steam-reaper which renders the operation unnecessary in mind, suggests that a tractor could be attached to the reaper-binder.

In this reaper, which was shown at the Universal Exhibition at Paris in 1878), the engine carried the jib of a crane *a* (see appended figure), and a windlass that could be coupled when required with the engine *n*; in front was a reaper, *M*, supported by the crane *a* which allowed the height of the stroke to be regulated. The reaper and the crane were connected with the engine *A* by two shafts *b* whose rotation axis *x* coincided with the transmission axis worked by a GALL chain. At the end of the machine, when it was necessary to turn, the mechanic raised the reaper *M* by engaging the windlass of the crane *a*.



The AVELING and PORTER Reaper-binder.

The AVELING and PORTER mounting with the crane jib and windlass can be used with advantage if a reaper-binder of the present type is attached to the fore-end of a tractor. The movement would be transmitted from the engine to the different parts of the reaper-binder by means of chains.

G. B.

323 - **Stooker for Large Threshing-Machine.** — SOURISSEAU, J. H., in *Journal d'Agriculture pratique*, Vol. 25, No. 16, pp. 314-316. Paris, April 23, 1921.

This elevator (constructed by the Society of the "Olive" Stokers, 32, Rue de Metz, Toulouse), works like a straw-stacker. It consists mainly of a carrier with chains mounted on the thresher.

The frame supporting the platform of the elevator is enabled, by means of a handwinch, to rise to the top of the rick and follow its level progressively as far as the ground.

The apparatus turns round a vertical axis and it can be pushed into any given position, so as to take sheaves on the right or left of the thresher. For purposes of transport the apparatus can be folded and arranged on the platform in such a manner as to take up less room. It is possible to combine the elevator with an automatic hopper.

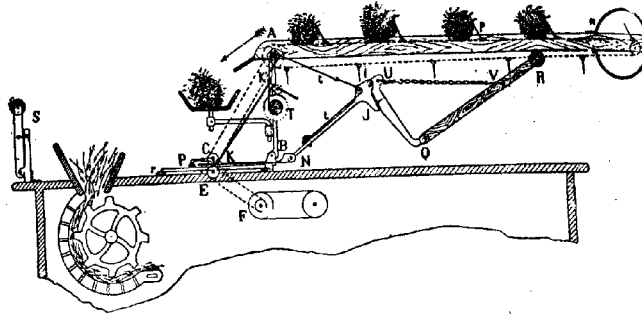


Fig. 1. — Elevator with automatic hopper, side view.

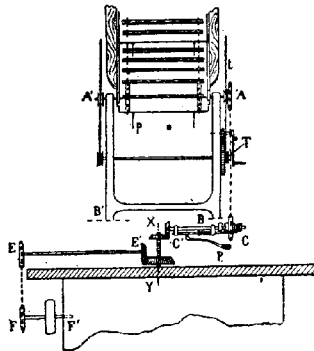


Fig. 2. — Stoker, end view.

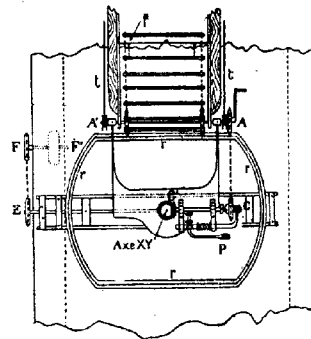


Fig. 3. — Stoker, plan.

TRANSMISSION OF THE MOVEMENT TO THE PLATFORM. — The platform is formed of two ledges fixed on two chains with detachable links passing over two cog-wheels, placed at either end of a wooden frame in the form of a ladder which is articulated with the shaft *AA* (figs. 1, 2 and 3). This shaft which transmits the motion to the platform is supported by a frame articulated at *BB*. This frame is kept vertical by the detachable props *KK'*. The shaft *AA* is governed by the transmission *AC, CC', XY, EE', FF'*. In order to catch the sheaves, the ledges are provided with points

P, kept in the position shown in the figure by means of an erg sliding into a groove at *U*. On the right of the shaft *AA*, the erg leaves the groove in *U*, its points become loose, and the sheaf falls into the cradle. Then the worker cuts the rope and throws the sheaf into the threshing machine, or automatic thresher.

A coupling device with claws is affixed to the shaft *CC'*. A pedal *P* which the worker can depress with his foot disengages it instantly.

RAISING AND LOWERING THE PLATFORM. — The frame supporting the platform is articulated with *AA*, it rests on a roller *R* which is kept in place by a system of pivoted levers *NI*, *IQ*, *QR*. The levers *IQ* and *QR* are connected by a chain *UV* with a swock-absorber hook and spring. The system *IQR* articulated with *I* rests on the erg, *J*.

A steel cable rolled on the drum *T* of a winch which is fixed on the vertical shaft *AB*, allows the platform carrying the sheaves to be raised or lowered with the raising or depressing of the lever *NJ* about the pivot *N*. A protecting hoop is fixed at the end of the trough.

ORIENTATION OF THE APPARATUS. — The elevator is mounted on a kind of turning-plate resting on a rail *r* (fig. 3) and turning about the axis *XY*. In whatever direction the apparatus is turned, the motion is transmitted by conical pinions.

FOLDING THE APPARATUS FOR TRANSPORT OF THE THRESHER AND SETTING FOR WORK. — The operations to be performed are as follows. Turn the apparatus through 180° from the position it occupies in fig. 1. Lower the platform until the two uprights of the frame rest on the supporting roller *S*, fixed at the end of the thresher. Raise the roller *R*. The steel cable *t* being no longer stretched is unhooked and the lever *QR* folded back on the lever *QI*. The vertical frame *AB*, is folded forward after unpinning the props at *K'*. The apparatus now rests on the turning-plate and the rail, the stacker being on the top. The machine is set up by reversing the above operations.

TESTS. — The author has tested this elevator upon a large threshing-machine with a beater 1.22 m. long and a platform 4.80 m. from the ground. The frame carrying the platform of the elevator measured 4.80 m.; the end of the frame could sink to the level of the ground, and rise to a height of 5.70 m.

The transmissions were arranged so as to make the platform travel 0.70 m. per second. The output has been estimated several times at 30 sheaves per minute. When working normally the machine uses on an average $\frac{1}{2}$ HP.

G. B.

324 — **The Laskowski Apparatus for Preventing Accidents during Threshing.** — *Deutsche Landwirt. Presse*, No. 15, p. 106. Berlin, February 25, 1921.

This apparatus consists of a metal frame of suitable height separating the thresher from the feeding-hopper; a grating protects him from falling grain.

G. B.

[323-324]

- 325 - Carrying the Harvest on a Light Road Tractor. — LIERMAN, M., in *Journal d'Agriculture pratique*, Vol. 36, No. 52, pp. 528-529. Paris, December 31, 1921.

The author gives the results obtained in transporting the harvest 1 km. by means of a light tractor towing 4 trucks which saves 20 % of the cost of using horses and carts. A saving of perhaps 40 % might be effected if 5 trucks were employed and the transport distance were limited to 1 km. or less.

G. B.

- 326 - The Guidetti and Piazza Cellar Presses. — CASTELLI U., in *La Macchina nell'Agricoltura*, Year 1, No. 10, pp. 9-11, figs. 4, Milan, December 1921.

The author describes two types of cellar presses of Italian manufacture which were commended at the "Esposizioni Romane riunite" held at Forlì towards the end of 1921.

Messrs GUIDETTI and Co. of Reggio Emilia make several kinds of hydraulic cellar presses with hand-pump.

The "GUMOR" type shown in fig. 1 has 2 cylinders with a conical axis; the larger cylinder which is under the basin, exerting the pressure and the smaller carrying out the return movement, both motions being produced by the help of a single hand-pump with two concentric pistons (for high and low pressure) and an intermediate tap with 3 screws.

This press is made in 4 sizes with a capacity of 400-500-668-808 litres respectively, the diameter of the basin being 0.80-0.90-1.00-1.10 m. and its height 0.80-0.80-0.85-0.85 m. The pressure exerted in order to obtain in the cage a pressure of about 9 kg. per sq. cm., varies from 170 to 250 atmospheres, or nearly double the pressure obtained with presses furnished with ordinary screws, in which case the ratio between the diameter of the screw and that of the cage would be 1 : 10.

Another press made by the same firm, the "B type", has one pressure cylinder, the cage and plate slide on a frame that rises against a fixed socket placed above it and supported by architraves and 2 columns, which is an arrangement similar to that customary in ordinary oil-presses. The return movement is produced by the weight of the movable part. Dimensions: diameter 1 m.; height of cage 0.85 m.; capacity 668 litres; pressure 12 kg. per sq. cm., works under a pressure of 285 atmospheres.

The same firm also makes presses with 2 or 4 rolling vats or reving vats.

Figure 2 shows the "Torchio continuo per mosti e vinacce" or continuous press for musts and pomace, of PIAZZA Bros. of Ravenna. In these vats pressure is applied by means of a single screw with horizontal axis, turning in a cylindrical cage and pushing forward the pomace that has been exhausted in the upper hopper, driving it towards the exit where the opening of the cage is circumscribed by a conical stopper provided with a pressurespring that can be regulated. The push and counter-push being transmitted to the axis of the screw, neutralise one another. A special contrivance prevents the contents being carried along by the rotatory motion. The machine is completed by apparatus for feeding, and transmission by fixed or free pulleys and if necessary by a frame and rammer. It can press 60 quintals of grapes in an hour.

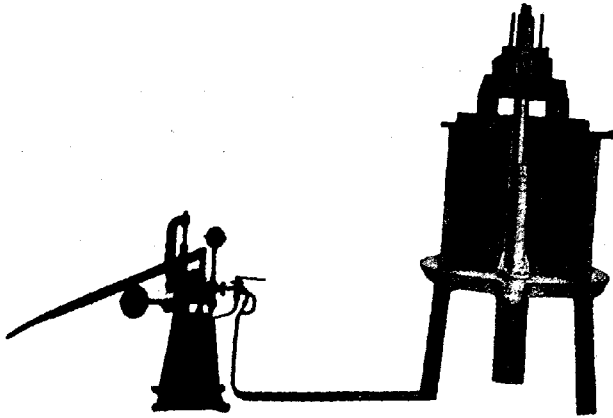


Figure 1. — GUMOR Press.

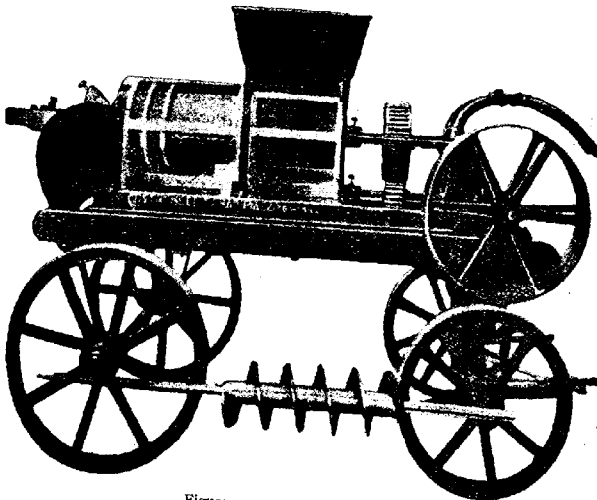


Figure 2. — PIAZZA Press.

F. D.

[326]

327 - **On the Choice of a Pump.** — RINGELMANN, M., in *Journal d'Agriculture pratique*, Vol. 36, No. 30, p. 91. Paris, July 30, 1921.

The author after calculating the water requirements of an agricultural farm during the various seasons of the year, describes the different engines that can be used to work the pumps.

For every plant this choice depends upon the type of engine, the water raised per second, and the total height to which the water has to be raised. Of the pumps that fulfil the required conditions, the one that works best and costs least for installation and maintenance should be chosen. The mechanical output, although important, ought not to play a preponderant part in deciding the choice of a pump.

G. B.

328 - **A Deep Suction Pump.** — *Deutsche Landwirtschaftliche Presse*, No. 1, pp. 3-4. Berlin, January 5, 1921.

With this special type of pump the usual depth of suction, which is practically 6 to 7 m., is raised to over 20 m. The pumping-engines are installed on the surface of the ground and the deep suction apparatus is sunk below the water-table.

G. B.

329 - **The Work of Teams** (1). — RINGELMANN, M., *Travail utilisable des attelages*, in *Journal d'Agriculture pratique*, Vol. 36, No. 47, p. 429. Paris, November 26, 1921. — II. IDEM, *Prix de revient de la journée de travail d'un cheval*, *Ibidem*, No. 38, p. 451. December 3, 1921. — III. IDEM, *Travail utilisé des attelages*, *Ibidem*, No. 49, pp. 472-473. December 10, 1921. — IV. IDEM, *Repartition du travail des attelages*, *Ibidem*, No. 52, pp. 529-531. December 31, 1921.

I. — It has been found that under normal conditions the field-work of teams lasts at least 3 hours less than the time intervening between sunrise and sunset. The author gives a graphic curve showing the actual monthly work of ploughing-teams, using as his basis the astronomical and meteorological data available.

II. — Taking into account the feeding, annual depreciation, shoeing, harness, interest on capital outlay and veterinary expenses, the author, basing his calculation on 275 work-days, reckons the cost of the team at 16.55 fr. per day without counting the expense of the driver.

III. — The author, basing his statements on notes taken in 1911, 1912, and 1913, at a farm in the South-west of the Department of Oise, divides the work of draught animals under its different heads. In the 2 busiest months (March and October), out of 100 working days, 32.5 and 28.1 are respectively devoted to ploughing, and 30.6 and 47 to carting.

Further the number of days when the animals are actually used, is less than the possible number; there being as a rule a deficit of 30 % charged on the general farming expenses.

IV. — The author continues his examination of these data. He shows that for various reasons it is impossible to turn to full account the draught animals on a farm, and determines for the case considered, the number which are unused most of the time and could with advantage be replaced by mechanical motor power.

G. B.

(1) See R. April 1921, No. 424. III. (Ed.)

330 - **Dynamometers.** — I. DESSAISAU, A., Dynamomètre pour Tracteurs, in *Journal d'Agriculture pratique*, Vol. 35, No. 25, p. 492, fig. 1. Paris, June 25, 1921. — II. MANN, G., Dynamomètre de rotation pour essai de machines agricoles, *Ibidem*, Vol. 36, No. 34, pp. 171-176. August 27, 1921.

I. — Description of an indicator with maxima needle.

II. — Description of the rotatory dynamometer used in testing agricultural machines. Calculations are made based on the degree of deformation of the springs.

G. B.

AGRICULTURAL INDUSTRIES

331 - **Investigations on Potato Storage during the Hot Season in Western India.** — MANN, H. H., and NAGPURKAR, S. D., in *Investigations on Potato Cultivation in Western India*, Bulletin No. 102 (of 1920), Department of Agriculture, Bombay, 1921.

The "heat rot" or "black heart" of potato has led to loss of germinating power and rendered potatoes useless for seed to a very large extent in Western India. The elimination of this form of rot in stored potatoes is a matter of serious importance at the present time. The authors here describe the best systems so far adopted.

Apart from actual diseases present in tubers, there appears to be no risk in storing at any temperature below 86° F and little danger below 90° F provided that there is sufficient aeration among the stored tubers. The period of danger is between early March and the end of May, or later when the monsoon rains are delayed. During this period the following method has proved distinctly advantageous: —

A shallow pit (usually 10 ft. long, 5 ft. wide and 18 in. deep) is dug under the shade of a tree or under a roof; this is filled with water which is allowed to soak away and the space to dry for 5 days.

The sorted potatoes are then heaped upon it, generally to a depth of 3 to 3½ ft. but sometimes as deep as 4 to 5 ft. and covered with a thick layer of grass or broad leaves. The temperature is kept down by occasionally filling a ditch dug round the pit with water and sprinkling the heap of potatoes. In such heaps the temperature has risen to 92 or 93° F but no higher. If the shade is considerable, the temperature does not rise to the same extent and in some cases has not exceeded 86° F.

Other cultivators have stored potatoes in substantially built store houses, usually in heaps from 2-3 ft. thick, and seed potatoes are turned and sorted frequently. The temperature in these heaps varied from 86 to 93° F.

It is considered likely that when the process of fumigation of potatoes becomes general and it is possible to reduce the damage done by the potato moth (*Phthorimea operculella*), these two methods will prove distinctly advantageous. Up till now, storage in bags has been found essential, in order to protect the fumigated seed from reinfection by moth. It has been shown that this caterpillar is an important means of spreading various rots, especially dry rot (*Fusarium*). A specially built storage house has been designed to protect against moth infection from outside and also

against high temperature and the resulting heat-rot. The plan of the building is as follows:— Double walls on all sides with air-space between; wire gauze over windows and door-space; roof of tiles, but underneath a ceiling covered with earth to a depth of 4 in.; ceiling open all round the edge and pierced by several openings in the centre; chimney to allow continual draught during hot weather; holes in floor connected with outside air by means of drain pipes partially filled with water; skeleton shelves to allow two layers of bags to be stored without in any way interfering with the aeration of either layer.

The store-room so built has been a distinct success in Poona and has to a large extent prevented rotting. The windows are kept open from 8 p. m. to 6 a. m. in the hot weather and then closed. The temperature has been kept as low as 82° F, when the temperature outside has risen to

101° F in the shade.

As a result of experiments made in various districts the following system appears to be advantageous. Within a week or 10 days of harvesting, the stock contained in bags should be fumigated with petrol vapour and subjected to selection for ring disease, dry rot, etc. The potatoes should then be re-bagged and if possible stored in a specially made house as described above. In the absence of special arrangements for a free draught of air, the open doors should be hung with canvas curtains kept moist during the hotter parts of the day.

M. L. Y.

332 - Changes occurring in Oranges in the Course of Preservation. -- ANDRÉ, G. i
Comptes rendus de l'Académie des Sciences, t. 173, No. 25, pp. 1399-1401. Paris
Dec. 19, 1921.

The author's experiments were made in the following manner. The oranges were divided into two groups of which one was subjected to analysis at once, while the other was superficially sterilised and preserved for 23 to 72 days in a sterilised vessel containing a small quantity of water and sealed with cottonwool. One sample was preserved in *vacuo*.

The respiratory strength of the oranges at ordinary temperature was measured by putting three whole fruits under a bell-glass in which a measured current of air circulated, this after its passage over the oranges traversing a solution of potash contained in two REISER tubes.

The results of the experiment showed that during preservation the process of ripening takes place in such a way that there is a marked diminution of acidity with a slight loss of sugar content. However, as these effects are also to be noted in *vacuo*, the diminution in acidity cannot be wholly attributable to oxidation but must partly be ascribed to decomposition of a diastatic nature.

F. D.

333 - Causes of Inferiority of Manila Hemp Fibres (*Musa Textilis*) in recent Consignments. — *Bulletin of the Imperial Institute*, Vol. XIX, No. 2, pp. 127-132
London, 1921.

Attention was drawn recently by a firm of fibre merchants to the fact that certain consignments of Manila hemp received in the United Kingdom had been found very deficient in strength. Samples of the defective

fibre were forwarded to the Imperial Institute for examination and the results of the investigation are here described.

Examination showed that the damage caused was due to a degradation of the cellulose, doubtless of bacterial origin, promoted by prolonged storage in a moist condition at a tropical temperature. This was confirmed by the fact that, on placing the fibre under similar conditions in the laboratory, the cellulose underwent further degradation and the fibre simultaneously increased in weakness. The fact that the storage of Manila hemp in a moist condition causes serious injury to the fibre is well-known in the Philippines, where hemp is most successfully cultivated, the rainfall is abundant and the bundles of wet fibre are packed indoors with the result that immense quantities of inferior fibre flood the market.

It is evident therefore that in order to avoid deterioration in Manila hemp, the utmost care should be exercised in drying the fibre and avoiding storage in a moist state.

Fermentation is liable to be more pronounced in the lower grades as they are not so well cleaned as fibre of the better qualities and contain more easily fermentable material in the form of parenchymatous tissue.

L. M. Y.

PLANT DISEASES

DISEASES NOT DUE TO PARASITES OR OF UNKNOWN ORIGIN

334 - Heat-rot or Black Heart in Potatoes in India. — See No. 331. of this Review.

335 - Further Researches on the Dry Gummosis of Citrus Trees (1). — SAVASTANO L., in *R. Stazione sperimentale di Agrumicoltura e Frutticoltura, Acireale, Bollettino* 12, pp. 1-6, figs. 9, Acireale, 1921.

An account is here given of the results of further studies of dry gummosis, "gommosi secca" or "mal secco", of citrus-trees.

Three districts where the citrus is largely grown were visited: the lemon-groves of S. Teresa-Riva (Prov. of Messina), the orange-gardens of Biancavilla (Prof. of Catania), and the orange and lemon gardens of the peninsula of Sorrento (Naples). In the last district the disease is of long standing and has assumed a more serious character of recent years.

In the plantations examined it was found that the malady occurs sporadically, that is to say, it attacks isolated trees and usually only a few branches are affected. It rarely happens that the disease assumes an intense form as at S. Teresa-Riva.

Lemon and orange-trees are equally liable to attack.

The author is of opinion that a careful investigation would reveal the presence of the disease in places which at first sight appear immune, especially in old or neglected citrus plantations.

The disease begins from two distinct points, viz., the apices of the young shoots of the season, and the woody shoots, branches and trunk. In both cases, it spreads downwards in the same manner as ordinary gummosis.

In the green branches the disease runs its course during the spring and summer. The tip becomes bent, turns yellow and withers; frequently there is exudation of a gummy liquid. The infection spreads down the branch and ceases on reaching a certain spot. Next year there is a recrudescence of the disease, which continues to descend and penetrates into the branch upon which the infected secondary branch is situated. The leaves and spines wither, the leaves becoming detached, while the spines remain. If the course of the malady is rapid, the infection spreads

(1) See *R.* Jan. 1922, No. 106. (Ed.)

the same year from the green to the woody branches, and the green branches usually wither completely.

In woody shoots, branches and trunks the disease follows the same course as ordinary gummosis, extending downwards between the bark and the wood, and the branches along its course wither. The bark retains its natural colour during the first period of the disease, so there is no sign of its presence underneath; herein dry gummosis differs from ordinary gummosis, as also in the fact that the bark does not finally become cracked but dries up and remains adherent to the wood. If a piece of the bark is removed, a gummy viscous liquid a little darker in colour than gum is found.

As the disease extends the foliage of the tree assumes a sickly aspect, and if it becomes aggravated the tree rapidly withers.

Occasionally the disease manifests itself in the form of patches, a gummy cortical spot forms round the bud which dries up. This is a localised form of gummosis.

Other fruit-trees, including those bearing stone-fruits, fruits with seed, and fig-trees, have been found in Sicily, Calabria and the Province of Naples to be attacked by a disease resembling the "mal secco" of the citrus.

This affection, according to the author, is to be attributed to the action of a bacterium, possibly *Bacterium gummi*. In California recently, *Bact. citra-refaciens* has been found to be the cause of a disease which from its microscopic characters is undoubtedly dry gummosis.

The bacteria cannot pass from tree to tree, nor even from one branch to another without an inoculating agent; in the present case the cause of infection was the common fly which the author has often seen in the act of sucking the exudation from infected branches. At S. Teresa-Riva the trees first attacked were in the neighbourhood of a farm which was naturally infested with flies.

Grafting is a direct cause of dry gummosis; of the two commonest forms cleft-grafting is the more and shield-grafting the less dangerous, for as the disease is seated between the bark and the wood, it is easy to detect its presence with shield grafting, whereas it often passes undetected in clefts. The disease is aggravated in many ways such as: intense manuring or want of manuring, triennial, irregular dressing, excessive or unseasonable irrigation, neglect in triennial pruning and too infrequent tillage.

As regards the treatment of dry gummosis, the author advises: 1) cutting off the young branches as soon as they are found to be infected; this fulfils the double purpose of suppressing a new centre of bacteria and of preventing the further spread of the disease by insect agency; 2) the removal of the entire large branch, even if only partly withered, should the first operation have been delayed, and the removal of the branch below the diseased patch; 3) raising with a knife a small portion of the bark of the diseased shoots and branches in order to see if the wood is healthy; should it prove infected, the wood must be probed till healthy tissue is found and all the branch below this point must be cut off. If there are any small gum-coloured spots, or

patches, the branch should be cut back to the healthy part; 4) cutting below the graft, if the trunk proves to be diseased and allowing the Seville orange to grow again, after which it must be re-grafted; 5) felling and uprooting the tree, if the stock itself is contaminated. The hole must be left open and exposed to the sun; in the spring another Seville orange-tree can be planted.

G. T.

DISEASES DUE TO FUNGI, BACTERIA AND OTHER LOWER PLANTS.

- 336 - "Excelsior" Oats Resistant to Rust in Brazil. — See No. 241 of this Review.
- 337 - Hybrid Potatoes resistant to Mildew (*Phytophthora infestans*) in France. — See No. 248 of this Review.
- 338 - Behaviour of different Varieties of Sugar Cane towards Diseases and Pests. — See No. 251 of this Review.
- 339 - Types of Sugar-Cane Native to Java, Resistant to Disease and to the Cane-Borer (*Diatraea saccharalis*). — See No. 270 of this Review.
- 340 - Types of North American Oats attacked by Rust, in Brazil. — See No. 241 of this Review.
- 341 - "Ring Disease" (*Bacillus Solanacearum*) and Dry Rot (*Fusarium* sp.) of the Potato, in India. — See No. 331 of this Review.
- 342 - Observations on *Dothidiella Ulei*, an Ascomycete Injurious to *Hevea Brasiliensis* in South America. — CAYLA, V., in *L'Agronomie Coloniale*, Year VI, No. 49, pp. 17-19. Rochefort, January 1922.

In 1912 the author observed that the leaves of some young specimens of *Hevea brasiliensis* growing in the experiment field at Belem de Para (Brazil), had been attacked by a cryptogamic disease. The latter was a tributable, according to GRIFFON and MAUBLANC, to the Ascomycete *Dothidella Ulei* Hennings (1).

By means of later researches made, not only at Para, but also in British Guiana and Surinam this disease was proved to be of very common occurrence in South America, and all the details of the complete life cycle of the parasitic fungus were discovered.

A scientific expedition made by the author in 1920 in Dutch Guiana confirmed the apprehensions already entertained as to the serious nature of the disease. The plantations of *H. brasiliensis* that had been made in this Colony are now abandoned and most of the trees have been felled, solely on account of the attacks of *Dothidella Ulei*. Even in the case of trees old enough for tapping, the leaves were so severely injured the laminae being riddled with holes, that they were no longer able to discharge their functions. The trees are in a wretched condition and even

(1) See R. July 1913, No. 885. (Ed.)

they do not die, are reduced to such a pitiable physiological state as to be unable to produce more than very small quantities of latex of no economic value. The rapidity with which the disease spreads varies according to the growth conditions and is greatest where the soil is damp and insufficiently drained. Badly attacked trees are however also to be found growing on healthy well-drained soils, on the highest dykes of the polders, and even on estates at a fair altitude.

The cultivation of *H. brasiliensis* has now been completely given up in Surinam.

From the information collected by the author in British Guiana it is easy to foretell that the same fate, due to the same cause, is awaiting the rubber plantations in the Colony, for in 1919 the acreage under *Hevea* had decreased to half what it had been a few years before.

Doth. Ulei is the pest threatening any *Hevea* plantations, that may possibly be established in Brazil in the future, and as the only economic solution of the problem of obtaining Brazilian rubber consists in growing *Hevea* on the banks of the Amazon, the necessary prophylactic measures must be adopted in making any new plantations.

G. T.

343 - *Vermicularia Capsici*, a Deuteromycete Injurious to *Capsicum annuum* and *C. frutescens*, in Bihar, India. — DASTUR J. F., in *Memoirs of the Department of Agriculture in India, Botanical Series*, Vol. XI, No. 5, pp. 129-144, pl. 2. Calcutta, 1921.

The most serious disease of chillies (*Capsicum annuum* and *C. frutescens*), in Bihar is the die-back disease due to *Vermicularia Capsici* Syd., which causes considerable damage to the crop in years where there is continuous rain or high humidity in the latter half of September and beginning of October. In Bihar the disease first appears at the end of September or in the first half of October, when the plants are mature and have begun to flower. It spreads rapidly from one field to another and in severe cases of attack, the plants are either completely killed or so badly diseased that the yield of healthy fruits is negligible. The first nip of the cold dry weather gives a sudden check to the progress of the disease which eventually dies away; the plants then recover and put forth healthy new shoots. The critical period when the plants are subject to the attack of the disease is therefore of short duration, about four to six weeks.

Plants growing under shade have been observed to suffer very little from this disease. Late sown crops are also very little affected, but give a very poor return. Fruits that mature before the beginning of December become badly diseased, to the extent of about 35 %, but those ripening later escape the disease, the percentage of infected fruits after the middle of the month being negligible.

On the stem the attack as a rule starts from the growing point or the flower bud, and therefore the presence of the disease in the early stage of attack is marked by the withering and turning brown of the top of the affected branches. The plant dies back as the attack spreads downwards and when it reaches a fork the infection runs up the sound limb. In some

cases the attack starts, not from the growing point but from a wound on the stem. As the disease progresses, the infected part of the stem assumes an enamelled white colour and is sharply marked off from the healthy green bark by a black line running round the whitened area. The white of the diseased part is punctuated by scattered, black, bristly and minute elevations which are the acervuli of the fungus.

The fruits become visibly diseased when they turn red, but very seldom while they are still green. The first outward sign of infection is the appearance of a small black circular speck, generally sharply defined but at times diffused. The disease does not spread concentrically, but rather in the direction of the long axis of the pod, so that the originally circular spot becomes more or less elliptical. As the infection progresses, the spot is either diffused and black, greenish-black, dirty grey or is markedly delimited by a thick and sharp black outline enclosing a lighter black or straw-coloured area. Two or more diseased spots may become confluent thereby destroying the regularity of the individual spots, but the delimiting black line is not always completely obliterated where the infected areas have united. Badly diseased pods lose their normal red colour and turn straw-coloured or in some cases pale white. The acervuli of the fungus are generally densely crowded together or else scattered; at times they are arranged concentrically. They project a little above the surface of the pod, and are bristly and carbonaceous. When a diseased pod is cut open the lower surface of the skin is found covered with minute, black, spherical elevations, which are the stromatic masses, or sclerotia of the fungus. In advanced cases the seeds are covered with a felt of white mycelium in which are embedded a few black or grey-green stromatic bodies. Infected seeds turn rusty in colour.

The author describes separately the microscopic characters of the disease on the stem, fruit, and seed and also gives an account of the cultural characters of the parasite. Cultures of the latter were inoculated with positive results on Chillies (seedlings grown in sterilised tubes containing moist plugs of cotton-wool; seeds removed aseptically from healthy pods and growing points and flowers of plants raised in pots; mature pods; seeds); *Carica Papaya* (very young flowers and fruits), *Vigna Catij* and *Dolichos Lablab* (fruits); *Solanum Melongena* (fruits), *Citrus* sp. inoculation experiments showed that the plants take the infection even when the humidity is very high. If it is reduced below a certain limit the progress of the disease is checked. Negative results were obtained in inoculations on mango (*Mangifera indica*), plantains (*Musa* sp.), French bean (*Phaseolus vulgaris*), sweet peas (*Lathyrus odorata*), onions (*Allium cepa*), sugar cane (*Saccharum officinarum*) and *Sorghum vulgare*.

It was at first supposed that seed selection would perhaps play an important part in controlling this disease, but the desired result has not been obtained under field conditions.

Experiments were also made in treating infected seeds with different strengths of copper sulphate solution and of formalin before sowing.

rate of germination was however not higher, for it was found that the fungus hibernates in the seed.

Further experiments in controlling the disease were made in 1917, on eight plots under Chillies. From the results obtained the following deductions can be drawn: The disease appears after the end of the rains in the first and second week of October; it attacks plants only at a definite stage of their development viz, when the flowers have set, and disappears as soon as the cold weather starts in the beginning of November. Fruits maturing before the beginning of December are much damaged by the disease, but the percentage of infection on fruits that ripen later is small. It seems therefore probable that if a late-maturing variety could be successfully grown in Bihar, it would escape the disease.

As the *Vermicularia* disease is very common on varieties of Chillies grown locally, tests were made of seeds from Bombay and Peshawar, where it had not been reported, in order to see if plants raised from them were disease-resistant. Unfortunately these varieties did not grow well at Bihar.

The plants growing under the shade of trees or other crops suffer less from the attacks of *V. Capsici* and *Choanephora Cucurbitarum* (B. and Rav.) Thaxt. The latter parasite had never before been noticed on Chillies, but caused great damage. It started from the flower or leaf-rod, and led to wet rot of the shoot. Moisture plays a very important part in the development and spread of the disease, and hence plants growing under shade remain healthy while those in the open are affected. In October and November, night dews and ground fogs are heavy and the plants consequently become very wet at night and remain so for some time after sunrise; this high humidity is favourable to the spread of the disease. Under shade, however, there is very little mist or dew-fall and consequently the atmosphere is comparatively dry, or at least dry enough to check the spread of the disease. The experiments made did not yield any practical results from which the effect of shade upon the total yield and the percentage of diseased fruits can be determined.

The application of 2 cwt. superphosphate + 1 cwt. nitrate of soda per acre not only increases the total yield of fruits, but also reduces the percentage of diseased fruits. It is doubtful if the use of artificial manures is possible on account of the present inflated prices.

Two applications of 1% Burgundy mixture are enough to control the disease, both on the plants and on the fruits. It is possible that only one application, if given at the right time, might be equally efficacious.

Healthy fruits from sprayed plants remain unspotted on drying, while those from unsprayed plants develop the disease.

Better results may be obtained by a combination of the application of manure and spraying with Burgundy mixture.

Late sown chillies suffer little from *V. capsici* and *Ch. Cucurbitarum*. Judging from the observations of the last few years, it would appear that the die-back disease in Bihar becomes virulent when the humidity per-

centage in the second half of September (when the plants begin to flower is on an average above 85. G. T.

344 - *Phyllosticta congesta*, a Deuteromycete Injurious to *Prunus triflora* in Georgia. — ROBERTS, J. W., in *Journal of Agricultural Research*, Vol. XXII, No. pp. 365-370, figs. 2, 1 plate. Washington, D. C., 1921.

In June 1905, near Fort Valley (Georgia) pickings were made of fruit and leaves of the Japanese plum (*Prunus triflora* Roxbg.) which had been attacked by a disease very closely resembling the apple blotch (*Phyllosticta solitaria* E. and E.). On May 27 1908, the disease was again observed on both fruit and foliage of the Burbank plum in Georgia. It was found to be rather common in several orchards near Montezuma, and in some cases caused enough damage to injure seriously the market value of the fruit. On May 29 1917, other Japanese plum-fruits and leaves affected by the same disease were found in the same locality.

The varieties of *P. triflora* known as Abundance and Burbank were those attacked and an unnamed seedling also probably belonging to *Prunus triflora*.

The affected parts on the unripe fruit appear as dark-coloured raised areas, with fringed margins and are somewhat roughened by the presence of small blisters and depressions. As in the case of apple-blotch the skin often becomes ruptured as the fruit increases in size. On the ripe fruit the portions covered by pustules appear as irregular brown areas 3 to 6 mm. in diameter and consisting of an aggregation of 4 to 20 sunken spots, each of which is 1 mm. or less in diameter. At this stage, the spots have a peculiar light blue cast owing to the "bloom" of the ripe plum covering the brown epidermis. The diseased area is rather superficial, extending only slightly below the epidermis. The affected tissues become hardened and somewhat leathery, showing no tendency to decay. Small glistening pycnidia are produced in considerable numbers even in the younger spots. On account of its characteristic appearance on the fruit, the disease has been given the popular name of "plum-blotch".

On the upper surface of the leaf blades, the spots are angular, rather small, brown when young, but later becoming grey or silvery in color. They may be numerous, as many as 200 sometimes appearing on a single leaf.

Usually one pycnidium only is present in each spot. Affected areas are also found on the petioles and on the veins of the lower surface of the leaf, especially on the midrib. On these the diseased areas are much larger than on the upper surface of the blade, and they are black and sunken. Pycnidia bearing spores are present in great abundance.

Pycnidia, apparently identical with those found in the fruit and leaves, were also seen in small light-coloured, often slightly sunken areas on the twigs.

The cause of plum blotch has been proved to be an organism identical with the fungus originally described by HEALD and WOLF as *Phyllosticta congesta* (1911), a parasite occurring on the leaves of the apple-tree in Tex

In the spring of 1918, no spores were obtained in cultures, but inoculations were made by spraying the young fruits and leaves of the varieties Abundance and Burbank with bits of hyphae and sterile pycnidia suspended in sterile distilled water. The results were negative in every case. In 1919 spores obtained from apple-twig cultures and suspended in sterile distilled water were applied to the fruit, foliage and twigs of "Abundance" plums. When cultures originally obtained from plum fruits were used, two fruits both with two typical blotches, and three leaves with dotted spots were found. Each of these spots bore a single pycnidium with the characteristic stylospores of *Phyllosticta congesta*.

Like results were obtained by the use of cultures obtained from the leaves; one fruit showed three typical blotches with pycnidia and two leaves showed one; seven leaves were successfully infected. From all these artificially inoculated parts, the fungus was re-isolated and proved to be *P. congesta*.

No lesions were found on the twigs.

Inoculations made upon *P. triflora* with stylospores from pure cultures of *Phyllosticta solitaria* gave negative results in 1918, 1919 and 1920, though the stylospores were applied to fruit foliage, and twigs at frequent intervals throughout the spring.

No attempts to control Plum Blotch have yet been made. G. T.

INJURIOUS INSECTS AND OTHER LOWER ANIMALS

5. Coccidae from the Seychelles (1). — GREEN, E. E., and LAING, F., in *Bulletin of Entomological Research*, Vol. XII, Part 2, pp. 125-128, figs. 4. London, 1921.

The list contains the following species of Coccidae collected in different parts of the Seychelles.

1) *Pseudoaonidia iota*, a new species found on the upper surface of leaf of *Eugenia caryophyllata*.

2) *Ps. alabraca* sp. n., on bark of "Bois d'Amande";

3) *Aonidia obtusa* sp. n., on *Verschaffeltia splendida*;

4) *Ceroplastes rubens* Mask, on *Acrostichum* sp. Widely distributed in the Australasian region.

5) *Chionaspis subcorticalis* Green, on tomatoes, and *Sida* sp. Hitherto recorded from Ceylon only.

6) *Pinnaspis buxi* Bouché, on *Pandanus Seychellarum*; also on *Areca catechu*, an almost cosmopolitan species.

7) *Diaspis (Aulacaspis) flacourtiae* Rutherf., on *Flacourtia*; this is the first time that any figures have been given for this species, which was previously known from Ceylon only, where the insect was observed to cause irregular and conspicuous swellings on the older and mature branches of its host.

G. T.

(1) See also R. Jan. 1917, No. 106. (Ed.)

stops. It is interesting to note that this evening cessation of movement occurs when the temperature is again near 13° - 15° C. All the observations so far made by the author have convinced him that the movements of the locust swarms are not determined by lack of food and hunger, as is the generally-accepted theory, but depend entirely on thermotropism (probably negative), and on another, as yet little known tropism which is displayed by the tendency of each larva to repeat the movements of its nearest fellows and to move in the same direction.

When the locusts are fit for flight, single individuals begin to take wing and fly for a short distance, often circling above the still sitting swarm. Whenever a locust flies near enough to another that is at rest, the latter is disturbed and often takes wing and flies in the same direction; this is again another manifestation of the same tropism which causes the movements of larval swarms. Sooner or later the whole swarm flies off. At first the insects do not take a definite direction, but as each individual tries to follow its nearest fellow, a common direction of flight must necessarily result. If two swarms meet, they mix together and the swarm gradually grows larger. The larger the swarms become, the longer and more regular also become their flights, and at last they assume a definite direction, and the insects take leave of their breeding region altogether. What is the cause of this emigration? The generally-accepted theory is that locusts migrate from want of food. The author however states that, as in the case of the larvae, hunger cannot be the incentive to emigration, especially if we consider the physiological changes occurring in locusts during the period of emigration. On dissecting individuals taken from emigrating swarms, it is seen that the greater portion of the inner cavity of the body is occupied by air-sacs, which are only temporary organs reaching their highest development at the period of emigration and disappearing towards the end of this period when the developing reproductive organs take their place. During the emigration, however, the air-sacs are enormously large and all the other internal organs, including the stomach, are much compressed, thus rendering the insect almost incapable of taking food, at any rate in large quantities. This assumption based upon anatomical facts, is supported also by field observations, for the emigrating swarms, when they stop their flight do not in fact feed much, though incidentally they may cause great damage by merely cutting the stems of cultivated plants.

Anatomical researches reveal also that the fat-body is more developed in insects just before and at the beginning of emigration, and is almost exhausted towards the end of it. Probably locusts during this period live essentially on the food-reserves in the fat-body, being unable to take much vegetable nourishment, and consequently scarcity or lack of food has nothing to do with the emigration.

In short, there is at present no possibility of explaining the emigration by any causes other than physiological; the development of the air-sacs compels the insects to fly, and this impulse is strengthened by their gregariousness, that is by some kind of tropism which makes each individual

keep close to its fellows and follow their movements. The reduction of the air-sacs and the exhaustion of the fat-body determines the cessation of the emigration.

The theory of phases suggests the theoretical possibility of the control of *migratoria* by some means directed not against the insect itself, but against certain natural conditions existing in breeding regions which are the direct cause of the swarming phase. Observations made in South Russia show that even comparatively slight cultivation of breeding-regions leads to the desired changes, preventing the transformation from the inoffensive solitary phase (*L. danica*) into the swarming phase (*L. migratoria*).

As regards *L. pardalina* Walk (for which as has already, said been the author created the new genus *Locustana*) the observations made by J. C. FAURE, in South Africa, and the author's examination of a large series of specimens from the same country have proved that like *Locusta migratoria*, it has two different phases, which differ in colour and morphologically, but more profoundly biologically. There is a sort of parallelism between the variation from the swarming phase (*Locustana pardalina* Walk.) and the solitary inoffensive phase to which the author has given the name of *Locustana solitaria*. The relations existing between *Locustana pardalina* and *L. solitaria* as regards morphological characters, the coloration in the larval and the adult stages, and the behaviour of the insect are very similar to those observed by the author in the case of *Locusta danica* and *L. migratoria*. J. C. FAURE's conclusions, which he arrived at quite independently of the author's work on *L. migratoria*, give a very strong support to the theory of phases as a direct cause of the periodicity of these locusts. It seems that in *pardalina* the transformation of solitary individuals into the swarming phase takes more than one generation, but the actual causes of the transformation are in this case as obscure as in *L. migratoria*. Data as to the migrations of the fliers and the fate of the migrating swarms of *pardalina* are not yet available. Further investigations of this problem closely connected with the careful study of all conditions of breeding-grounds, are extremely important from the point of view of locust control in South Africa.

G. T.

347 - *Isaria Eristalidis*, a Hyphomycete living on the Dipteron, *Eristalis tenax*, in Japan. — YASUDA, A., in *The Botanical Magazine*, Vol. XXXV, No. 420, pp. 219-221.

This article contains a description of three new species of *Isaria* found in Japan living on insects: *I. japonica*, *I. Cosmopsaltriae* and *I. Eristalidis*. The last was observed on pupae of *Eristalis tenax* L. (European Drone-fly) (1), in the Province of Harima.

G. T.

(1) See R. Jan. 1919, No. 138. (Ed.)

- 348 - New Species of Indian Braconidae. — LYLE, G. T., *Bulletin of Entomological Research*, Vol. XII, Part. 2, pp. 129-132, figs. 2. London, 1921.

The author gives a description of the following species which are new to science :

- 1) *Microplitis similis* sp. n., a parasite of *Agrostis ypsilon* L., collected at Pusa and Sabour (Bihar and Orissa), and at Mokamah (Bengal) ;
- 2) *Microplitis eusirus* sp. n., reared from *Achaea janata* L., at Pusa ;
- 3) *Rhogas (Heterogamus) percurrans* sp. n. also reared from *A. janata*, at Pusa. G. T.

- 349 - Control Measures against the "Pink Boll-Worm" (*Gelechia Gossypiella*) of the Cotton Plant, in Egypt. — See No. 263 of this Review.

- 350 - The Control of the Olive Fly (*Dacus oleae*) during 1920, in Greece. — ISAAKIDES, C. A., Report of the work of the Phytopathological Service in Controlling *Dacus* during the Year 1920 in Chalcidice, Pelion and Messenia and of the results obtained, 18 pp., pl. 3. Athens, 1921.

In Greece, the olive-fly (*Dacus oleae*) causes an average annual loss of 25 000 000 "okes" of oil (1 oka = 2.755 lb), which at present price means a loss of 100 000 "drachmas" (1 drachma = 9²³/₆₄d. at par).

For a long time and on many occasions experiments in controlling the pest had already been made on a small scale ; mixtures with an arsenical base having been used with encouraging results, but it was not till 1920 that this method was adopted over an extensive area and for a really large number of olive-trees.

Operations on a larger scale against the olive fly were facilitated by the institution (by virtue of law No. 1366, of 1918) of the "Olive Bank" which was founded for the express purpose of providing the means of protecting and freeing the olive-tree from its animal and plant enemies. The funds of this Bank are supplied by : 1) a special tax on olives and olive-oil ; 2) a State grant ; 3) the profits from re-selling the ingredients, instruments and all apparatus necessary for controlling parasites. By Royal Decree, the special additional tax is levied on districts which already pay the tax on olives and olive-oil and where the communes have requested through their municipal councils that this tax should be imposed, in order that they may enjoy the advantages offered by the Bank.

The amount of this extra tax is apportioned in such a manner that part of the expenses of the Bank is defrayed by the State, and part by the olive-growers. The duties of the Bank consist in buying and distributing the ingredients and apparatus, giving information respecting the control of the parasites of the olive-tree and in itself carrying out the necessary treatments and thus setting an example to others.

The organisation and supervision of the scientific work of the Bank are entrusted to the Government Phytopathological Service.

It was decided in 1920 to adopt the usual measures against the Olive-fly at Polyghyros (Chalchidice), a district where there are about 150 000 olive-trees, in the Pelion district (about 2 700 000 olive-trees), and at Kyparissia, Erani and Platamodes (Messinia) (about 7 000 000 olive-trees), the total number of trees to be treated being 3 500 000.

On account of their size, the territories of Pelion and Kyparissia, Erani and Platamodes were divided into several sections in order to facilitate the control campaign. From one to four gangs of workers were appointed to each section, their number being proportionate to that of the trees and such as to allow each treatment to be applied within about a month. The work was directed and carried out entirely by an expert Staff under the general supervision of the Phytopathological Service.

According to the recommendations of the Service, the olive-trees were to be given during the 1920 season three successive sprayings, after which three vessels containing the insecticide mixture should be provided for every hundred olive-trees.

This mixture was composed of sodium arsenite $3 \frac{1}{3}$ kg.; molasses 110 kg.; water 10 hectolitres.

According to the instructions given, about 320 gm. of the mixture were to be used for a tree of average size; it was however found at Polyghyros, that 250 gm. were enough, and that larger amounts scorched the young leaves and shoots and also the fruits, without proving any more destructive to the olive flies.

In Pelion on the other hand, where the trees are larger, it was thought advisable to spray each tree with 320 gm. of the mixture the first time, 460 gm. the second, and with a still larger quantity for the third. After a few days' practice, the workers are able to spray each tree with the required amount of the mixture and one man can treat about 800 trees a day. In the case of the first and second sprayings, the mixture must be spread upon the interior of the foliage, but the third spraying must be directed upon the exterior of the tree, where the olive-flies are to be found at that time.

In all the zone to be treated, the first spraying must be begun towards the second fortnight in June, the lowest lying districts and those most attacked by the insect being first treated.

The second spraying begins towards the end of July and lasts about one month. The third treatment was begun at Polyghyros on August 22nd and finished on September 6th. In Pelion and Messenia, it was begun early in September and prolonged until the end of the month or the beginning of October. In every case untreated olive-trees were left as controls. Difficulties of a practical nature made it impossible to place the three series of vessels among the trees. As the three sprayings had proved satisfactory and are easier to carry out than fixing the vessels in the trees and keeping them replenished with the mixture which quickly evaporates, it was decided to substitute a fourth spraying for this part of the treatment. This spraying began on September 21 and finished on October 8 at Polyghyros and was generally adopted. In Pelion,

however, it lasted throughout October, but was only carried out in the districts most exposed to attack, this being all that was possible owing to the rains. In Messenia a few trees only were sprayed four times.

In spite of all the precautions adopted, it proved impossible to prevent all the injuries inseparably connected with the use of the insecticide, though considering the extent of the area in which the control was carried out, the cases of burns among the workers and transport animals were not frequent.

The application of the mixture with a molasses base caused the disappearance of ordinary flies and was also efficacious in destroying another Dipteron which is injurious to the olive-trees, *Lasioptera berlesiana* Paoli, known in Greece under the popular name of "xerouvoula". On the other hand, as was proved by special experiments, the mixture is harmless to bees.

Most satisfactory results were obtained by the control operations carried out in 1920 in Chalcidice, Pelion and Messenia. As a rule, 50, 80 and even 100 % of the fruit of untreated trees was attacked by the olive-fly, whereas all the trees that were sprayed remained perfectly immune. No occurrence of "fumagine" was observed as a result of the dachicida sprayings in any of the districts where the treatment was adopted.

A total of 8 341 kg. of arsenite of sodium and about 260 tons of molasses were used. The cost of the treatment at Polygyros, Pelion and Messenia amounted to 622 563 drachmas (1 drachma = $9\frac{33}{64}$ d. at par).

The larger crop of better quality obtained in 1920 owing to the control operations, brought in an immediate return of about 20 000 000 drachmas to the olive-growers, while the state benefited to the amount of over 800 000 drachmas, this being the tax on the part of the crop that had been preserved from the attack of *Dacus oleae*. G. T.

351 - *Phthorimaea operculella* in Tunisia (1). — POUTIERS, R., in *Bulletin de la Société entomologique de France*, No. 2, pp. 30-31. Paris, 1922.

Phthorimaea operculella Zell, was found in October 1921 in Tunisia, but only at Sousse, where it had been introduced a few weeks previously. From enquiries made on the spot, it appears that this Microlepidopteron was disseminated in the district by some thousand kilos of Maltese potatoes which had been put on the market for "seed". Under such special conditions *Phthorimaea operculella* might easily spread, but as a very small quantity of potatoes are produced in Tunisia and these are quickly consumed, the insect will probably have little chance of living long or multiplying in the country. Further the Tunisian Agricultural Authorities have adopted certain measures of supervision which justify the hope that even if the pest succeeds in establishing itself in the neighbourhood of Sousse, it will be possible to destroy it on its first appearance elsewhere, or at least to prevent its spreading over a wider area.

(1) See R. Feb. 1922, No. 220. (Ed.)

If the infected potatoes were really grown in Malta from which they were shipped, the fact is one of considerable interest, as Malta will in that case have to be added to the list of places where *Phl. operculella* is already known to work havoc. G. T.

352 - "Potato Moth" (*Pthorimaea operculella*) in India. — See No. 351 of this Review.

353 - *Neurotoma nemoralis*, a Hymenopteron Injurious to the Peach-tree, in France. — PAILLOT, in *Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol VII, No. 38, pp. 827-831. Paris, 1921.

The existence of the peach-tree orchards in the Rhone valley is seriously threatened by the Hymenopteron, *Neurotoma* (*Lyda*, *Pamphilus*) *nemoralis*. So far the damage seems to be confined to the territory of the Communes of Saint-Rambert d'Albon (Drôme), Adancette (Drôme) and Saint Désirat (Ardèche), but the advance of the insect is rather rapid. At Saint-Rambert the area of peach orchards utterly destroyed was three to four hectares in 1920, but rose to fifteen hectares in 1921, and it is probable the invasion will extend still further in 1922.

The author, from his own observations and the information collected in the course of his enquiries, is inclined to believe that the first appearance of *Neurotoma nemoralis* is confined to small centres that quickly extend from year to year. The development of these centres should be carefully watched and the insects destroyed before they have time to spread further.

In 1921 the moths began to fly towards the end of April, but the chief laying season never begins before the 10th of May. The larvae hatch out six or eight days after the eggs are laid according to the temperature, and attain their full size in about a fortnight, when they burrow into the soil in order to pass the winter underground.

In 1921 the author began at Saint-Rambert, a series of experiments in treating the centres where the largest number of moths had been seen on the wing and many eggs had been deposited in the leaves.

Experiment I. — Nicotine and soft soap :

Nicotine (100 gm. per litre)	1 1/2 litre
Soft Soap	2 kg.
Water	100 litres

The treatment was carried out on May 16th with a knapsack-sprayer, throwing a jet of 2 m; the hatching out of the larvae had just commenced.

Experiment II — *Quassia amara* and soft soap :

<i>Quassia</i> (in chips)	1 kg.
Soft soap	1.500 kg.
Water	100 litres

The decoction of *Quassia* is prepared by boiling the chips for two hours in several litres of water. The treatment was carried out on the same estate where the nicotine had been sprayed previously.

Experiment III — White hellebore powder and gelatine:

White hellebore (rhizome)	1.250 kg.
Gelatine	100 gm.
Water	100 litres

Treatment carried out on May 14th under the same conditions and in the same orchards that had been sprayed with the other two mixtures.

Experiment IV. — Nicotined lime.

A powder prepared by slaking quick lime with weak tobacco juice. An ordinary sulphating apparatus is used. Treatment carried out May 14th.

By way of experiment a late spraying was made with arsenate of lead towards the end of May, in an orchard that had suffered greatly from the ravages of the insect. It was most efficacious, but unfortunately the use of this insecticide cannot be recommended, as the French law prohibits the employment of arsenical mixtures after the flowering season, in the case of trees bearing stone-fruit.

The results of the spraying, as observed on May 28, were as follows:

Peach-trees treated with nicotine, *Quassia* and hellebore at the beginning of the hatching out of the larvae: condition very good;

Peach-trees treated with nicotine several days after the larvae hatched out; less satisfactory; a fairly large number of living caterpillars present.

Peach-trees dusted over with nicotined lime: little different from the controls.

The formulae most to be recommended at present are those with a nicotine and *Quassia* base; hellebore is efficacious but somewhat difficult to obtain. If the trees are very severely attacked, two sprayings are necessary at intervals of 5 to 6 days; the first should be carried out as soon as the larvae begin to make their appearance. G. T.

354 — The Coccid, *Chrysomphalus aurantii*, in the Colony of Kenya, East Africa. — DRY, F. W., in *Bulletin of Entomological Research*, Vol. XII, Part I, pp. 103-104. London, 1921.

The presence of *Chrysomphalus aurantii* Mask. on the citrus-trees of the Colony of Kenya was reported for the first time in 1914. It is known that the Coccid was introduced by at least one consignment of imported citrus fruit which as it was provided with a certificate of immunity by the exporting country, had been admitted into the Colony without inspection. Thus it appears probable that *Chrys. aurantii* is not indigenous to Kenya. For this reason efforts were at once made to prevent its establishing itself in the Colony and with the hope of saving the citrus trees, and of preventing the pest attacking the coffee plantations, which are of far greater importance to Kenya than the orange and lemon groves, all importation of citrus fruits was at once prohibited and owners of citrus trees were required to destroy any that had been attacked by the Coccid.

Since 1917 the citrus gardens and nurseries have been inspected, and the owners requested to communicate the results of their investigations. It was ascertained in this way that *Chrys. aurantii* was widely distributed in the Colony, where it had attacked a large number of trees.

The insect was not only found on citrus trees, but also on rose-bushes, the apple-tree, plum-tree and on sisal.

Laboratory and field experiments have shown that so far the coffee trees have fortunately remained free from the pest.

The life-cycle of *Chrys. aurantii* has been followed in citrus fruits, but 'unluckily' the extermination of the insect appears to be practically impossible. Since fumigation would be too costly, spraying is recommended as the best means of control.

G. T.

355 - *Rhagoletis suavis*, a Dipteron Injurious to *Juglans* spp., in the United States. — BROOKS, F. D., in *United States Department of Agriculture, Bulletin* No. 992, pp. 1-8, pl. 4. Washington, D. C., 1921.

Rhagoletis suavis (Loew) probably occurs fairly generally throughout the area of the natural distribution of *Juglans nigra* and *J. cinerea*. It has been found in the following States of the North American Confederation: Massachusetts, Minnesota, Indiana, Connecticut, New York, Ohio, District of Columbia and Virginia.

This dipteron chiefly attacks the husks (epicarp), of *J. nigra* and *J. cinerea*. The author has however reared adult specimens of *Rh. suavis* from the husks of *J. regia* and *J. Sieboldiana*. Amongst these hosts the black walnut (*J. nigra*) and the Persian walnut (*J. regia*) are preferred to the others, probably on account of their thicker husks.

In the case of *J. nigra*, the eggs of the parasite are usually deposited so late in the season that the larvae do not prevent the nuts from ripening and dropping normally. Thus while apparently all the eggs are laid in nuts on the trees, the development of the larvae and the blackening of the husks which results from their feeding takes place chiefly in fallen nuts. In *J. regia* however the eggs appear to be laid earlier in the development of the nuts. Walnut-trees in Maryland and Pennsylvania were seen shortly before the crop ripened, to have a large percentage of the husks of the nuts blackened and the surface covered with a gummy exudation from the larval injury within. Some of the infested *J. regia* fruits drop prematurely, and others hang to the branches until after the sound nuts have fallen. In nuts attacked before maturity, the development is arrested and the kernel becomes unfit for use. The injury is thus threefold: the quality of the kernel is impaired, the husk sticks to the shell in the hulling process and the shell itself is discoloured making the nuts unattractive for market.

The author gives a detailed description of the different stages of the insect's development and of its habits.

Hitherto one parasite only of *Rh. suavis* has been discovered; this is a hymenopteron, *Aphaereta auripes* Prov. reared from the puparia of the Dipteron at Amherst (Massachusetts). A Rhynchote (*Lopidea*

sp.) was surprised by the author with its beak inserted through the skin of a black walnut sucking out the contents of a batch of freshly-laid *Rh. suavis* eggs.

In 1920 experiments in controlling the husk-maggot (*Rh. suavis*) were made with lead-arsenate sprays during the first ten days of August on two groves of *R. regia* laden with fruit, the one in Maryland and the other in Pennsylvania.

At New Windsor (Maryland), 3 pounds of lead-arsenate paste to 50 gallons of water were used for spraying; at West Willow 1 ½ pounds of lead arsenate powder to 50 gallons of water were applied; and some of the trees were sprayed with a lead-arsenate solution to which enough molasses had been added to give the liquid a slightly sweetish taste.

The trees of both groves had borne the previous season but the crops had been seriously injured by the larvae of *Rh. suavis*.

At the time the groves were sprayed the adult Diptera were appearing on the trees, and at West Willow a close examination of the nuts disclosed one batch of freshly laid eggs.

The nuts of the trees that had been sprayed at New Windsor were examined and counted just before the crop was gathered, and it was found that only 4 % of the nuts had been destroyed by the larvae, while at least 60 % had been attacked the previous year. At West Willow it was estimated that the conditions were 75 % better than the year before when no treatment was given. No Persian Walnut trees were found near either place that were suitable for use in checking the definite results of the spraying, but a comparison of the sprayed nuts with those produced by the same trees the previous season, together with the known abundance of the flies that appeared early upon the sprayed trees indicates decidedly beneficial results from the treatment.

Adult specimens of *Rh. suavis*, when confined in roomy wire-screen cages, were also observed to feed freely on sweetened water to which sufficient lead arsenate had been added to give the liquid a milky colour though it must be admitted that these flies succumbed very slowly to the poison. More tests of this treatment must be made before it can be recommended unreservedly as an effective and sure method of control for this pest.

G. T.

356 - *Chloryta lybica* n. sp., a Rhyncote Injurious to the Vine in Libia. — DE BERGEVIN, E., and ZANON, V., in *L'Agricoltura Coloniale*, Year XVI, No. 2, pp. 58-64, figs. 4. Borgo S. Lorenzo, February 1922.

In 1918, V. ZANON observed for the first time some isolated vine-stocks in a vineyard at Berka (Benghasi), which had yellowish second shoots (*feminelle* and *sottofeminelle*), although the July foliage as a rule quickly assumes the dark green colour of the spring leaves.

In the following years, the vines with yellowish leaves did not occur isolated, but in groups scattered throughout the vineyard; and also, whereas at first the lighter colour of the young leaves was due to the presence of yellow patches, these now extended over the surface of the

leaf which became wrinkled and curled, the edges being affected with necrosis, and finally fell. In addition all these second shoots were rachitic, and their internodes were shortened; at the same time a superproduction of buds was observed.

This affection had also been noticed in other vineyards at Berka, although no reason could be assigned for it until in August 1920, ZANON while examining a similarly affected vine on a trellis at Fuehat, found upon the lower surface of its leaves a light-green Rhynchote, only a few millimetres in length and possessing great powers of jumping. After investigating all the vines that he knew to be abnormal, he became convinced that the affection was due to the Rhynchote which punctured the leaves, thus causing them to turn yellow and fall. The puncture also acted as a stimulus causing the production of superfluous buds.

ZANON suspects that the supposed outbreak of Bramble-leaf recently reported in Tripolitania (1) was due to the effects of the attack of this Rhynchote, which E. de BERGEVIN regards as a species new to science and describes under the name of *Chlorita lybica*.

G. T.

357 - **New Species of Curculionidae attacking Forest Trees in India.** — MARSHALL, G. A. K., in *Bulletin of Entomological Research*, Vol. XII, Part 2, pp. 165-180, figs. 1-3. London, 1921.

In this paper the author describes the following *Curculionidae*:

1) *Sympiezomias beesoni* sp. n. found in several parts of the Province of Madras feeding on the leaves of young teak (*Tectona grandis*), and in some cases defoliating the trees.

2) *Alcides dipterocarpi* sp. n. bred from seeds of *Dipterocarpus*, at Dehra-Dun (United Provinces).

3) *Mecistocerus fumosus* sp. n. on *Pinus longifolia* and bred from the latter host-plant, in different places in the United Provinces and Punjab.

4) *Rhadinomerus bombacis* sp. n. bred from *Bombax Malabarica*, at Pathri, Sarhanpur (United Provinces) and at Singhbhum (Bihar and Orissa).

5) *Rh. diversipes* sp. n., bred from *Eugenia Jaman*, *Shorea robusta* and *Shorea* sp., in several parts of the United Provinces.

6) *Rh. malloti* sp. n., bred from *Mallotus philippinensis*, at Lachiwala, Dehra-Dun (United Provinces).

7) *Rh. subfasciatus* sp. n., bred from *Shorea robusta* and *Shorea* sp. respectively at Jhabberkhet, Dehra-Dun and Kotdrawara, Lamsdowne Division (United Provinces), and from *Eugenia* sp. at Thano, Siwalik Hills (Punjab).

8) *Rh. buteae* sp. n. reared from *Butea frondosa*, at Rani Range, Siwalik Hills (Punjab).

9) *Osphilia odinae* sp. n., bred from *Odina Wodier* and *Cassia Fisula*, in several places in the United Provinces.

G. T.

(1) See R. Nov. 1921, No 1174. (Ed.)

- 358 - The Tussock Moth (*Lymantria monacha*), in Valais, Switzerland. - BARBEY, A., in *Journal forestier suisse*, Year LXXIII, No. 2, pp. 21-25, 1 pl. Berne, February 1922.

The Tussock Moth (*Lymantria monacha*), made its appearance in Haut Valais, in 1921, in the lower part of the Cooches Valley (Gomserthal), where the Macrolepidopteron was on August 5th suddenly found to have invaded the Communal forest of Ermen. The zone attacked was situated at an altitude varying from 950 to 1000 metres and had a superficial area of about one hectare. It had been planted some 60 to 80 years previously, with *Picea* (Spruce) asto $\frac{9}{10}$ and *Pinus sylvestris* (Scots pine) asto $\frac{1}{10}$, all the trees were in good condition at the time, some of the spruces having attained the height of 24 metres.

The rains that fell towards the middle of August had hindered the insects from swarming and laying, but some of the moths had previously succeeded in depositing their eggs under the scales and within the crevices of the bark of the trees, choosing by preference those that had been severely damaged by the caterpillars. On September 15th countless clusters of eggs were found surrounding the lower portions of tree trunks of every size in the infested zone. On some trees a cluster was found on an average on every square decimetre. On the spruces and Scots pines alike, chrysalids and the remains of caterpillars and adult insect were discovered bearing traces of the attacks of their natural enemies.

The most likely explanation of this invasion would seem to be the following: the Tussock moth, which is of sporadic occurrence in Switzerland, succeeded in 1920 or possibly in the preceding year, owing to favourable meteorological conditions in penetrating into the Rhone valley from the basin of the Léman. Some couples of the Macrolepidopteron meeting in the Grengiols pass found their way, into the Forest of Ermen. The exceptional warmth of the spring and early summer of 1921 following a very mild winter caused the eggs that had been deposited in large numbers in July 1920, to hatch out. It is also possible that this part of the Conches Valley may have harboured this macrolepidopteron for years though the insects may not have succeeded before the summer of 1920 in laying a large quantity of fertile eggs.

Orders were at once given to fell during the winter all withered or half-withered trees having a great number of egg-clusters on the scales of their bark. As all trees attacked by the Tussock moth are irretrievably lost, these measures were adopted to prevent any subsequent incursion of xylophagous insects which generally act as secondary enemies.

The infested bark must of course be scrupulously burnt, and a careful supervision exercised over the surroundings of the infected zone, in order to ascertain that the invasion has been effectively checked. G. T.

- 359 - *Platypus omnivorus*, a Beetle Injurious to Wood, in New South Wales. - FROGGATT, W. W., in *The Agricultural Gazette of New South Wales*, Vol. XXXII, Part 9, pp. 645-648, 1 pl. Sydney, 1921.

Platypus omnivorus Lea (the shot-hole borer), which was first recorded from Tasmania, is widely distributed through the New South

Wales coastal forests where it is commonly known as "brushes", or "cellar brushes".

The beetle is not noticeable during the winter months but is very active in December, January and February. It not only penetrates into the sap-wood but bores into the solid material of the logs for some distance. It also attacks newly-sawn boards while drying, but when after exposure for a month or so, the sap dries out, the timber loses its attraction and the borers leave it alone.

The principal timbers damaged by these beetles are beech (*Trochocarpa laurina*), blackwood (*Acacia melanoxylon*), corkwood (*Schizomeria ovata*), sassafras (*Doryphora sassafras*) and coachwood (*Ceratopetalum apetalum*).

The general opinion of investigators is that preventive measures are the only means of combating insects of this type; such measures consist in the removal of all dead and dying trees from the forest area, and their destruction before the beetles develop and emerge from the infested wood.

When timber has been cut and stacked it is still liable to infestation until it is quite dry. The beetles can, however, be kept away by the use of carbolic acid sawdust sprinkled beneath the stack and between the layers of boards and battens as they are stacked. A 5 % solution of water and carbolic acid is mixed in a bucket of sawdust and the moist sawdust is freely sprinkled over the timber. A saw-miller to whom this method of treatment was recommended has had no further complaints to make of damage by the beetle to his timber since he has adopted these precautions.

G. T.

[359]